

THE PERCEPTION OF AIR POLLUTION  
IN EDINBURGH

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## ABSTRACT

Man reacts to environment not as it is objectively, but as it is known to him. This study examines the congruence of awareness and "reality" of air pollution for residents of Edinburgh, with a view to identifying typical response groupings in terms of their various characteristics, including socio-economic, life situation, and personality variables.

The approach involves a review of basic ideas about perception in psychology, the past application of these ideas to geographical problems, and their previous use in studies dealing specifically with human response to air pollution. The Edinburgh case study, based on an areally stratified random sample and 540 face-to-face interviews, is interpreted against the historical background of national and local experience with pollution control.

Hypotheses, suggested by past studies and derived from an adaptation of existing theory on man's perception of natural hazards, are tested in joint frequency distributions. The extent of patterning within the interview data is then examined using factor analysis.

A general correspondence was observed between monitored pollution levels and expressed awareness and concern. Among the socio-economic variables considered, age was most related to interview responses. Information receipts and personality characteristics are identified as dimensions which require further attention in future studies.



## DECLARATION

This thesis has been composed by the undersigned  
and is based on his own research.

15 May, 1973.

## ACKNOWLEDGEMENTS

Data for this thesis could not have been collected without the careful work of the interviewers and the time granted them by Edinburgh residents; may these volumes go some toward repaying their investments. Data was also provided by the Edinburgh Health Services Department, and valuable co-operation extended by the Smoke Control Officer, Mr. E. Turner.

Professor Ian Burton, Dr. Geoff Wall, and Dr. Mark Blacksell each contributed significantly to the second stage of the project, carried out in June of 1971, and particularly to the design of the questionnaire used at that time.

I am indebted to Dr. A.J. Crosbie who supervised the work from its inception and made important editorial suggestions. His encouragement and that of my fellow post-graduates was especially welcome. I also wish to express appreciation to Mrs. Marjory Dodd who typed ably and with great dedication throughout the project, to Mr. Thomas Waugh for advice on computer programming, and to Mr. Eric Anderson for his comments on the factor analysis chapter. This help is gratefully recognised, but it is also acknowledged that responsibility for errors and omissions remains solely with the author.

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Finally, and most of all, my appreciation goes to my wife, whose faith, patience and encouragement made this work possible at all.

J.D.B.

## F O R W A R D

Graphs and numerical data are collected at the front of Volume Two for each chapter, in sequence. Appendices form the final section of that volume, except for the interview schedules (Appendices 4 and 5) which are found in the pocket at its back, along with a reference map of Edinburgh. (Map 8-1)

The tables show raw frequency ("Count") and percentage of total responses ("Tot pct") for each cell up to Table 9-148, after which row and column percentages are also included because these proportions are occasionally mentioned in comment on the later tables.

To save space, certain abbreviations were employed in the tables. These included S, PB, M, L, B, and CC for the names of the sampling areas, Stenhouse, Portobello, Morningside, Leith, Bellevue, and Central City. Yes and no were shortened to Y and N; agree and disagree to A and D. Statistical significance was rendered as S.S.

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INTRODUCTION

This study is concerned with the perception of the physical environment, that is with the way in which meanings are attached to surroundings. The particular aspect involved, air pollution, was chosen, in a general sense because of rising world concern with the impact of man's waste disposal on atmospheric systems. Specifically, this was a promising subject in the Edinburgh context because the city's air pollution problem was not as major and obvious as in certain larger cities in less ventilated latitudes and situations; yet Edinburgh has had sufficient experience of air pollution to earn the name "Auld Reekie". Therefore a variety of opinion was expected as to the existence and saliency of air pollution in the city. This was seen as offering an opportunity to correlate human response with such data as could be collected on the information flows to which the people were exposed, and with objective assessments of the pollution levels in which they lived and worked. The latter data derived from the Edinburgh University Department of Geography Air Pollution Survey,<sup>1</sup> which began operation in 1962, and from the local Public Health Department, which carried out monitoring of smoke and SO<sub>2</sub> as part of the National Survey of Atmospheric Pollution.<sup>2</sup>

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1. CROSBIE, A.J., CROSBIE, N.J., and DICK, J.H.A.  
Air pollution in Edinburgh. Ms. Part 1. 1968.
  2. The investigation of air pollution: directory of sites.  
Ministry of Technology. Warren Spring Laboratory.  
1969.



## THE STRUCTURE OF THE THESIS

The process by which man attaches significance to his environment has occupied speculative minds throughout the ages, but in modern times psychology has taken this as a special province. Accordingly, this work begins by examining psychologists' conclusions about perception, with reference to its bearing upon geographers' principal concern, the significance of the physical world. Geographers' investigations of these subjective meanings in a wide range of environmental contexts are examined in a review of their behavioural research. This is followed by an evaluation of research by a variety of social scientists focussing specifically on the human response to air pollution. Variation in such human response is then traced through British history, with Edinburgh taken as the prime Scottish example.

On the basis of these reviews a general research strategy was adopted involving a standardized questionnaire, face-to-face interviewing, and a sample survey methodology.

Work on the thesis, which was begun in August of 1969, has been reported at the UNESCO Seminar on Natural Hazards,<sup>3</sup> and to the I.G.U. Commission on Man and Environment.<sup>4</sup> The part of the project which was supported by Resources for the Future is

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3. BILLINGSLEY, J.D. and CROSBIE, A.J. 1971.  
Perception of air pollution in Edinburgh: background and methodology.  
Presented to UNESCO Seminar on Natural Hazards.  
Godollo, Hungary, August 4-9, 1971.
  4. BILLINGSLEY, J.D. 1972.  
Air pollution in Edinburgh: private perceptions and public policy.  
Presented to the Man and Environment Commission Symposium.  
Calgary, Alberta. July 23-31, 1972.

also reported in an inter-city comparison of human response to air pollution in the United Kingdom. <sup>5</sup>

#### IMPLICATIONS OF THE RESEARCH

Such formalized approaches to the assessment of opinion on questions of environmental quality have practical potential in that they offer some estimate of the concerns and priorities of the people for whom environmental changes are being designed, or whose ideas and attitudes governments may wish to lead. As the Ashby Report <sup>6</sup> said, "... one contribution which government can make will be to stimulate a wider understanding by the public of the pollution problem and a more active public interest in its control." If such a project is to have a chance of success, it will be necessary to understand first approximately what each segment of the population believe to be true about the specific problem, and equally, where they gain such information. These are two areas in which perception research, using sample survey techniques, can assist.

Another practical application of this approach, developing now in North America, links perception research to the legal definition of unacceptable standards of environmental quality.

- 
5. BLACKSELL, M., WALL, G. and BILLINGSLEY, J.D.  
The human dimensions of air pollution in Exeter, Sheffield and Edinburgh.  
Forthcoming in:  
BURTON, I. (ed.)  
Social response to air pollution in the United Kingdom.  
University of Toronto Press.
  6. ASHBY, Sir Eric (Chairman).  
Royal Commission on Environmental Pollution - first report.  
London. H.M.S.O. 1971. P.8.

The state of Iowa air pollution control commission are currently drafting regulations under which an odour will be deemed legally objectionable "... if it occurs more than once in three months, and if it is offensive to thirty percent of at least thirty randomly selected residents of an area." <sup>7</sup>

The importance of basing action on peoples' knowledge and belief is not only recognized by Western leaders; Kromm's recent sample survey of public awareness and concern with air pollution in Ljubljana, Yugoslavia <sup>8</sup> brought a government request that the same methodology be used to investigate popular views about the existing and desired availability of recreational facilities in the area.

People can respond only to situations or problems that they recognize. If awareness is lacking, concern is not possible; if concern is lacking, action is not supported. This case study in environmental perception investigates the meaning of one aspect of the physical setting, air pollution, for a sample of Edinburgh residents, with a view to better understanding of the process by which surroundings are endowed with meaning.

7. Time. January 1, 1973. P.30.

8. KROMM, D.E. and VIZJAK, S.  
Response to air pollution in Ljubljana, Yugoslavia.  
Paper: Man and Environment Commission Symposium.  
Calgary. July 24-30, 1972.

PART I      THE RESEARCH BACKGROUND

## Chapter 2

### SOME ASPECTS OF PERCEPTION THEORY IN PSYCHOLOGY

#### INTRODUCTION

Behavioural geography has been described as "a new grab-sweep into one of the few behavioural sciences hitherto untouched by predatory geographers".<sup>1</sup> Yet, this recent effort by geographers to master psychological techniques and to appreciate psychological perspectives flows irresistably from the geographer's traditional concern with the significance of environment. This now includes, for an increasing group, not only its significance for trained geographers, but also for others with different purposes and points of view. These geographers seek to understand the human implications of distributions, as they occur in all the complexity of an everyday world setting.

Perception is central to a wide range of disciplines from philosophy to painting, but it is investigated directly in psychology. It seems reasonable, therefore, to look to psychological theory for insight into the nature of perception and how it may be specified in a research design. Much of the psychologist's laboratory experimentation seems of marginal relevance to geographical problems, although many psychologists have put forward behavioural theories that do suggest useful insights.

The discussion below is not intended as a summary of

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1. BROOKFIELD, H.C. 1969.  
On the environment as perceived.  
In BOARD, C. et al (eds.)  
Progress in Geography 1.  
London. Edward Arnold Publishers Ltd. Pp. 53-58. P.53.

perception in psychology. It is rather a limited investigation of what psychology has to offer as a workable explanation of how significance is attributed to sense experience.

#### THE EMPIRICISTS

At the end of the nineteenth century, the founders of psychology were building on the empiricist views of John Locke <sup>2</sup> and David Hume <sup>3</sup> to form what is now termed Stimulus-Response or S-R theory. Men were thought to begin life with a "blank slate". All knowledge was held to result from subsequent sense experience with the environment. The frequency <sup>4</sup> of such contacts created mental links of association <sup>5</sup> of varying strengths. Helmholtz believed these links included assumptions about the physical world, which themselves could influence future perceptions by a process which he called "unconscious inference". <sup>6</sup>

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2. LOCKE, J. 1690.  
An essay concerning human understanding.  
WILBURN, R. (ed.)  
London. Everyman's Library. No. 984. 1959.
  3. SELBY-BIGGE, L.A. (ed.)  
HUME, D. 1740.  
A treatise of human nature.  
Oxford. Clarendon. 1958.
  4. OLDFIELD, R.C. and OLDFIELD, K.C. 1951.  
Hartley's observations on man.  
Annals of Science 7, 371-381.
  5. MILL, J.  
Analysis of the phenomena of the mind. 2 volumes.  
London. Longmans Green Reader and Dyer. 1869.
  6. HOMANS, G.C.  
Herman Von Helmholtz.  
In SILLS, D. (ed.)  
International encyclopedia of the social sciences. <sup>6</sup>  
Corwell, Collier and MacMillan. 1968. Pp. 345-351.

These ideas were elaborated in the "enrichment theories" of James and Tichnor during the first two decades of the twentieth century. <sup>7</sup> Tichnor distinguished between the very rare "pure" perception, in which response is totally to the sense stimulus, and the more usual "mixed" perception in which the context of observation and memories of similar past situations influence meaning. James defined perception as "the consciousness of particular materially present objects". <sup>8</sup> He emphasized the "constructive role of past experience" in building such consciousness, contending that in a given stimulus situation one tends to perceive the thing that, from past experience, would most usually give the present sensation.

These early behaviourists were much concerned with following the "scientific" approaches of natural philosophy. Because subjective perceptions were accessible only to the perceiver and could not be publically and objectively verified, and because science must have objective data, subjective perceptual theories could not be scientific. They, therefore, held that only overt behaviour was legitimate matter for scientific study. These researchers emphasized rigidly controlled laboratory observation of overt responses to distal stimuli. They tended to ignore intervening processes between experimental stimulus and observable response, and eschewed all introspective evidence.

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7. BEVAN, W. 1958.  
Perception: evolution of a concept.  
Psychological Review 65 (1), 34-55.
  8. KORNER, S.  
Kant.  
London. Penguin Books. 1953.

## GESTALT

The Gestalt school arose during the second decade of the twentieth century as a reaction to the philosophical assumptions of the Empiricists, and to their tendency to dissect experience until the result bore only the most tenuous relationship to everyday life. Gestalt rejected the current atomistic belief that understanding of a phenomenon could only proceed by restructuring from its essential constituent units. Its philosophical basis derived from Kantian nativism<sup>8</sup> and from the phenomenology of Katz,<sup>9</sup> with its stress on naive, objective observation of the total physical world of normal life.

Emphasis was on unity and wholeness and innate thought processes. Gestalt asserted that each observation had a counterpart in the observer's mind, "psychoneural isomorphism". Further, and basic to this point of view, was the "Law of Prägnanz" which proposed that "processes in the brain (and hence in experience) distribute themselves in such a way as to produce maximum order and simplicity".<sup>10</sup> Thus, perceptual organization was thought to be innately determined by the nature of the nervous system itself. This spontaneous organization was thought to be in accordance with the principles of proximity, similarity, closure, common fate and good continuation.

In Gestalt "experiments" independent variables are the environmental factors, in all their dimensions and relationships;

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9. PRENTICE, W.C.H.  
The systematic psychology of Wolfgang Kohler.  
In KOCH, S. (ed.)  
Psychology: a study of a science. Study 1. Volume 1.  
London. McGraw-Hill Book Company, Inc. 1959.  
Pp. 427-455. Pp. 428-429.

10. Ibid.



dependent variables are the responses, overt or covert, as observed or inferred by the scientist/observer. A catch phrase frequently associated with Gestalt is, "The whole is greater than the sum of its parts". That is, a total configuration is held to have properties not obtainable by summing the individual parts, which are in turn affected by their position relative to the whole. For example, if a population with modern industrial skills are located near deposits of both coal and iron ore, possibilities arise that would not be available if any one constituent was absent.

#### CHANGING EMPHASIS IN THE MODERN PERIOD

Doctrinaire nativist and empiricist positions with their reliance on a priori assumptions, as described above, are no longer tenable.<sup>11</sup> Modern researchers increasingly include motivation, perceiver attitudes and states, and effects of past stimulation as factors in perception. Theory is frequently expressed in schematic models, of varying breadth and complexity, which are used to generate hypotheses for empirical testing. In short, researchers in this area are no longer concerned with the sole aim of discovering the essence of perception, rather, they are seeking the processes involved.

Aside from this effort to understand the processes operating in perception, there seems little else unifying this research. Investigation appears to be proceeding in semi-isolated cells, with the assumption that a detailed knowledge of particular

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11. GIBSON, J.J. and GIBSON, E.J. 1955.  
Perceptual learning: differentiation or enrichment.  
Psychological Review 62, 32-41.

aspects of perception will make possible the discovery of basic underlying principles common to all perceptual processes.<sup>12</sup>

A brief sampling of these research "cells" is included below.

#### Depth perception

Depth perception involves studies of shape or solidity of perceived objects, as well as their distance from the perceiver. By implication, abstract space is involved as the medium in which objects and perceiver are located.<sup>13</sup>

#### Perceptual constancy

Studies of perceptual constancy investigate the familiar phenomenon whereby objects retain such characteristics as colour, form, and size even though observed from different angles, distances, contexts and lighting conditions. A familiar example is the perception of a coin as circular even though its retinal image is clearly an ellipse.<sup>14</sup>

#### Illusions

Illusions are studied as errors in perception, that is, perceptions which, if translated into behaviour, would be likely

12. WARR, P.B. and KNAPPER, C.  
The perception of people and events.  
London. John Wiley and Sons. 1968. P.32.
13. GIBSON, J.J.  
Perception as a function of stimulation.  
In KOCH, S. (ed.)  
Psychology: a study of a science. Study 1. Volume 1.  
London. McGraw-Hill Book Company, Inc. 1959. Pp. 456-501.
14. HELSON, H.  
Adaptation level theory.  
In KOCH, S. (ed.)  
Psychology: a study of a science. Study 1. Volume 1.  
London. McGraw-Hill Book Company, Inc. 1959. Pp. 565-621.

to run amok in the physical world.<sup>15</sup> Experimentally, such incorrect perception has been induced by using inverting glasses and by such drugs as mescaline.<sup>16</sup> Perceptual errors due to "figural after-effects" have been shown to follow repeated experience of the same stimulus. Gibson's report of a curved surface coming to appear flat after continued stroking is a familiar example.<sup>17</sup>

#### Sensory deprivation

The effects of solitary confinement on prisoners of war and the necessity for men to function in synthetic environments of space vehicles and submarines, inspired investigation of behavioural effects of "severe reduction in the variability of sensory and perceptual stimulation".<sup>18</sup> Marked disturbances were noted in perception, thinking, emotions, and motivation, often accompanied by hallucination.

#### Speech perception

The study of speech perception involves recognition of

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15. WEINTRAUB, D.J. and WALKER, E.L.  
Perception.  
Belmont, California. Brooks/Cole Publishing Co. 1966.  
Pp. 1-5.
  16. HUXLEY, A.  
The doors of perception.  
London. Chatto and Windus. 1956.
  17. GIBSON, J.J. 1937.  
Adaptation with negative after-effect.  
Psychol. Rev. 44, 222-243.  
Quoted from: GIBSON, J.J. Op. cit.
  18. ZUBEC, J.P. 1964.  
Prolonged sensory and perceptual deprivation.  
British Medical Bulletin. 20, 38-42.

basic sound units of language and their combinations into words. Clues of syntax, enunciation, and familiarity with the language, as well as competing noise, also influence speech perception.<sup>19</sup>

#### Person perception

Warr and Knapper define person perception as "the processes involved in knowing the external and internal states of other people".<sup>20</sup> Although there are similarities with object perception, inference by empathy is a strong factor in person perception.

#### Social perception

Social perception is the research area of psychology most obviously related to environmental perception in geography.<sup>21</sup> Social psychology is generally concerned with the effects of social and cultural influences on how men conceive of their surroundings.<sup>22</sup> Cross-cultural studies of this type seek to isolate the effects of past experience on perception. The functions of interests, needs, values, and goals in directing perception to a particular aspect of the immediately observable

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19. BLACK, J.W. and AGNELLO, J.G. 1964.  
The prediction of the effects of combined deterrents to intelligibility.  
J. of Auditory Research 4, 277-284.
  20. WARR, P.B. and KNAPPER, C. Op. cit. P.2.
  21. SAARINEN, T.F. 1969.  
Perception of environment.  
Commission on College Geography, Resource Paper No. 5.  
Assoc. Am. Geog. Washington, D.C.
  22. BROWN, R.  
Social psychology.  
London. Collier-MacMillan Ltd. 1965. xix-xxiv.

environment are considered as "motivational factors". Culture has been found to have great influence in matters such as religion and aesthetics which cannot be easily verified by direct personal observation.<sup>23</sup> The main focus in social perception is on the group rather than on individual perceivers.

#### MODERN GESTALT

The theoretical position of modern Gestalt is that the relationship between environmental factors and behavioural responses are facts of nature to be discerned, not prescribed. Hypothetical constructs have value, in these terms, insofar as they explain data and aid in "coordination and mutual understanding with other earth sciences".<sup>24</sup> One such hypothesis is that certain gross relationships govern any animal's behaviour in its environment. For example, some effort must be made to get food. But specifically what effort and toward what kind of food may be a matter of sudden insight, or recognition of new possibilities in the surroundings.

Modern Gestalt holds that perceptual constancies of colour and size are independent of learning and judgement, as these have been observed in lower animals and children. It has been suggested that a more parsimonious explanation is that all required cues for these effects are available in the given stimulus field.<sup>25</sup>

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23. TRIANDIS, H.C.  
Cultural influences upon cognitive processes.  
In BERKOWITZ, L. (ed.)  
Advances in experimental social psychology. Volume 1.  
London. Academic Press. 1964. Pp. 1-48.

24. PRENTICE, W.C.H. Op. cit. P.444.

Gestalt is a point of view more than a theory. It advocates intuitive organization of direct sensory impressions. The view applies best where objectively determined stimulus properties override past experience and knowledge. Its lack of a developmental theory to explain differences between adult and child perception, and its failure to incorporate effects of memory on perception, cause Prentice to conclude that Gestalt is not a complete theory explaining all kinds of perceptual behaviour. <sup>26</sup>

Phenomenological ideas are, at once, antecedent to and a component of modern Gestalt. They emphasize unbiased observation and description; experiments to find the "essential determinants" of phenomena; and revision of theory in the light of the new principles discovered. MacLeod develops this "field" concept to embrace what he calls "psychological geography", the geography of men's minds. "The famous 'New Yorker's map of the United States' will be closer to the psychological truth than the geographer's map will be." <sup>27</sup> This kind of geography, he contends, involves the location and evaluation of the "essential social structures" of the individual perceiver's world.

Kurt Lewin's "life space" or "field" theory extends these

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- 25. OSGOOD, C.E. 1953.  
Method and theory in experimental psychology.  
London. Oxford University Press. 1959.
  - 26. PRENTICE, W.C.H. Op. cit.
  - 27. MACLEOD, R.B.  
The phenomenological approach to social psychology.  
In TAGIURI, R. and PETRUCCIO, L.  
Person perception and interpersonal behaviour.  
Stanford. Stanford University Press. 1958. Pp. 33-53.

ideas, at the same time continuing to use the Gestalt analogies to mathematical concepts of space, force, and tension.<sup>28</sup> Field theory is described as "a method of analysing causal relations and of building scientific constructs".<sup>29</sup> The field at a given time includes the physical, psychological, and cultural environments of the individual. Its properties are those that exist for that individual. Although the field is modified by history and acted upon by events, at a specific time only the contemporary system can have an effect. The time interval considered as "contemporary" will determine the extent of the field.<sup>30</sup> The field for an individual, at a given time, includes:

- a) his psychological past;
- b) his psychological future;
- c) his time perspective;
- d) those sections of the physical and social world affecting him at that time.

"Psychological past" involves the person's views about his own past and about the physical and social world. "Psychological future" includes his hopes, daydreams, and fantasies about the future.<sup>31</sup> "Time perspective", a term coined by L.K. Frank in

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28. LEWIN, K.  
CARTWRIGHT, D. (ed.)  
Field theory in the social sciences.  
London. Tavistock Publications. 1952.

29. Ibid. P.45.

30. Ibid. Pp. 51-52.

31. Ibid. Pp. 54-59.

1939, influences ambition, constructiveness, initiative, and to some extent, mood.<sup>32</sup> For example, the prisoner who eagerly anticipates his freedom will "suffer" more than his cellmate with no thought for tomorrow. Each of these four major factors defining the field is composed of a number of "dimensions", some of which may involve subjective probabilities, or expectancies.

#### MODERN PSYCHOPHYSICS

In modern psychophysics, the heir to the S-R school, emphasis is also on perception as a process involving the perceiver in his functional habitat. But here, the main focus is on sense discrimination of stimuli. In Gibson's "Perception as a function of stimulation", perception is defined as the "process by which an individual maintains contact with his environment."<sup>33</sup> Emphasis is on perception as a process and focus is on the time scales, objects, and situations encountered in everyday life. The habitat is seen to offer a "continuous flux" of potential stimulus energies, but perception is limited by the nature of human sensory apparatus, and by its fitness and state of maturity. A particular energy variable may not be perceived because of lack of training in its discrimination, or due to want of attention for a variety of reasons. As subjective meanings are built up through repeated association of, for example, a given action, the "super abundant stimulus flux at the receptors" becomes differentiated.<sup>34</sup>

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32. FRANK, L.K. 1939.  
Time perspectives.  
J. Social Phil. 1, 293-312.  
Quoted from: LEWIN, K. Op. cit. P.53.

33. GIBSON, J.J. Op. cit. Pp. 456-459.

34. Ibid. P.477.



"Stimulation", in this theory, is on a macro scale affecting whole sense organs rather than individual cells. Sense information may arrive simultaneously from more than one mode, thus increasing confidence in the validity of resulting perceptions. This approach is not concerned with illusions arising from contradictory sense impressions or errors. It does, however, recognize that all stimulation is inexact due to receptor limitations, so that all perception is based on more or less accurate "correlates" of the thing observed. <sup>35</sup>

The basic hypothesis, or statement of faith, for this group, as put forward by Gibson, is that ". . . for every aspect of property of the phenomenal world of an individual in contact with his environment, however subtle, there is a variable of energy flux at his receptors, however complex, with which the phenomenal property would correspond . . .". <sup>36</sup> Perception involving learning, reasoning, abstract thinking, or indirect perception via books, records, or pictures are held to be of a more complex nature and should be tackled only when simple perceptions are understood.

#### ADAPTATION LEVEL THEORY

Adaptation level theory, to some extent, straddles the gap between modern Gestalt and Psychophysics. In this theory, the perceptual experience is analyzed into three components: the immediate stimulus; the immediate stimulus context; and "residual factors". The first two are external and may be

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35. Ibid. P.472.

36. Ibid. P.465.

sufficient to explain behaviour; residuals are the complex internal attributes of the perceiver, including his mental and physical states, and memories of past experience. This residue of past experience forms the basis of subjective probabilities which in turn provide expectancies and affective components to response. Where residuals have minimal power, immediate, insightful learning may occur in direct reaction to the stimulus situation. These three factors, stimulus, context, and residuals are seen to balance off, producing a "behavioural homeostasis" peculiar to an individual at a given time. The position of neutral point in this balance, called the adaptation level, is crucial because it determines whether a sensation will be considered, for example, warm or cold; pleasant or unpleasant.

Analagous to this is base level theory, as put forth by Jones and Davis.<sup>37</sup> This theory arises from an examination of how one person attributes intentions and dispositions to another on the basis of observed actions.<sup>38</sup> It is suggested that people carry with them a series of standards or concepts of what an "average person" would do in a given situation. Observed behaviour is unconsciously compared to the relevant standard or "base level". The greater the deviation from the expected average, the greater the value of the particular ob-

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37. JONES, E.E. and DAVIS, K.E.  
From acts to dispositions: the attribution process in person perception.  
In BERKOWITZ, L. Op. cit. Pp. 219-266.

38. BLAKE, R.R.  
The other person in the situation.  
In TAGIURI, R. and PETRULIO, L.  
Person perception and interpersonal behaviour.  
Stanford. Stanford University Press. 1958. Pp. 229-242.

servation as a basis for making inferences about the dispositional characteristics of the person.

#### INFORMATION THEORY

Terms from communication theory have been used to conceptualize perception processes. This involves ideas of "input", "noise", "encoding", "decoding", and "output" as information from a stimulus object reaches the perceiver. Although these terms provide convenient analogies when redefined to their new context, information theory itself does not easily deal with affective and expectancy dimensions in perception. <sup>39</sup>

#### PHYSIOLOGICAL PERCEPTION MODELS

According to Hebb's cell assembly theory of perceptual development an organism begins life with excitation in the nervous system little more than a random distribution. <sup>40</sup> By repeated experience with the environment a state of "nonsensory unity" is reached wherein neurons become organized into functional units called cell assemblies. With still more experience, the "identity" of objects and their relationships become known. At this stage neural activity involves combinations of cell assemblies operating as phase sequences.

Recent work at Edinburgh University has extended Hebb's theory to include spectral storage of information in aggregate groupings of hundreds of thousands of cells which "fire" together in response to a certain level and pattern of sense

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39. WARR, P.B. and KNAPPER, C. Op. cit. Pp. 6-7.

40. HEEB, D.O.  
The organization of behaviour.  
London. Chapman and Hall Ltd. 1949.

stimulation, or to an act of will. <sup>41</sup>

#### SENSORY-TONIC FIELD THEORY

In contrast to Hebb's strongly empirical model, sensory-tonic field theory grows out of Gestalt psychology. <sup>42</sup>

"Sensory", refers to internal factors of muscular and organic activity. According to the theory, the body seeks to keep the two sets of inputs in balance. Imbalance results in a perceived shift in the position of objects or a reorientation of the body. Different inputs could thus give the same results. This is not a general formulation, and is particularly concerned with visual cues and gravity stress.

#### FUNCTIONALISM

Egon Brunswik's probabilistic functionalism <sup>43</sup> seeks to relate the structure of perception to the pattern of past experience, while stressing the processes involved in an organism's adjustment to its environment. Sense information from the environment is held to be unreliable, in varying degrees, due to limitations of sense receptors in capacity, area, and period of observation, and due to the variable nature of many aspects of environment. For these reasons Brunswik suggests an aggregation and weighting process must be performed on sense data to con-

41. LONGUET-HIGGINS, H.C.  
Associative memory models.  
Lecture presented at King's Buildings, University of  
Edinburgh. November 11, 1970.
42. WEINTRAUB, D.J. and WALKER, E.L. Op. cit. P.5.
43. POSTMAN, L. and TOLMAN, E.C.  
Brunswik's probabilistic functionalism.  
In KOCH, S. (ed.) Op. cit. Pp. 502-564.

struct a "cue family hierarchy". Position on this hierarchy relates to an unconscious and almost instantaneous probability assessment of the chance of successful response if a given cue or group of cues is used as a basis for behaviour. This "intuitive statistician" uses past experience to assign probabilities. <sup>44</sup>

The priority ranking of cues is shown, in Figure 2-1, as occurring in the lens, after energy levels have impinged on the sense organs. If the "central response" is the basis of successful behaviour, the "distal variable" is "achieved", and the "functional validity" of the response is established. In this event, the cue ranking is reinforced. If, however, the response is functionally invalid, confidence in that cue family weighting will be weakened. Success of environmental function is seen as the arbiter of the perceptual process, which Brunswik describes as "a complex instrument aiming at a mapping of the distal environment into the organism". <sup>45</sup> In application of this theory to research, Brunswik emphasizes the need to study the individual as he functions in the full complexity of his everyday environment. In his "representative design" approach, natural situations are the sampling units within which individuals are observed in the context of their normal ecological influences. <sup>46</sup>

The "transactionalist approach", as summarized by Hadley

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44. BRUNSWIK, E.  
Perception and the representative design of psychological experiments.  
Los Angeles. University of California Press. 1956.
45. Ibid. P.145.
46. POSTMAN, L. and TOLMAN, E.C. Op. cit. P.520.

Cantril <sup>47</sup> takes a strongly empiricist view of the perception process. Devices for structuring sense information are seen as deriving from individual experience in a cultural setting. Speech requires focusing, categorizing, and coding; analysis requires conceptualizing. Facilities for coding and conceptualizing are built by "doing" in the environment, and are constantly in need of revision, in varying degrees, and with varying frequencies, as experience points up shortcomings in existing constructs.

The need for constant revision of concepts led the transactionalists to emphasize modes of action in the environment, rather than the organizing concepts themselves. Bridgeman summarized their position in this way:

"... we have thus been led to discard the common sense method of handling our environment in terms of objects with properties, and have substituted for it a point of view that regards a reduction to activities or operations as a safer and better method of analysis . . . What we are in effect doing, in thus preferring the operational attack, is to say what we do in meeting new physical situations has a greater stability than the situations themselves, and that we can go further without revising our operations than we can without revising our pictures of the properties of objects". <sup>48</sup>

The focus in this approach is thus on the process of experiencing, by an active, perceiving individual. Operations involved in creative thinking and radically divergent conceptual advances

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47. CANTRIL, H. 1960.  
Concerning the nature of perception.  
Proceedings of the American Philosophical Society 104 (5),  
467-473.
48. BRIDGEMAN, P.W. 1950-51.  
The operational aspects of meaning.  
Synthese 8, 255-257.  
Quoted from: CANTRIL, H. Op. cit.

are not part of this approach.

#### COGNITIVE DISSONANCE THEORY

In the past fifteen years, Leon Festinger's theory of cognitive dissonance has generated a great deal of both research and controversy.<sup>49</sup> A "dissonant relation" is said to "exist between two things which occur together, if, in some way, they do not belong together or fit together".<sup>50</sup> For example, if a person working in highly polluted air has positive views about his employer's efforts to safeguard his workers, he would be faced with a "cognitive dissonance" situation if told that his exposure to air pollution could damage his health.

Aronson reports that difficulties in delimiting applications of the theory arise because the inconsistency involved is psychological rather than strictly logical.<sup>51</sup> He points out that dissonance situations may result from logical inconsistency, from inconsistency with cultural mores, from inconsistency between one cognition and a more general, higher order cognition, or from inconsistency with one's own past experience.

There are marked individual differences in dissonance effects. People differ in the amount of dissonant information they can comfortably tolerate. Methods of dissonance reduction vary. What is dissonant for one person may be quite compatible with the ideas of another.

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49. ARONSON, E.

The theory of cognitive dissonance: a current perspective.

In BERKOWITZ, L. (ed.)

Advances in experimental social psychology. Volume 4.  
London. Academic Press. 1969. Pp. 1-35.

50. FESTINGER, L. 1958.

The motivating effect of cognitive dissonance.

In LINDZEY, G. (ed.)

Assessment of human motives.

New York. Holt, Rinehart and Winston. 1961. Pp. 65-86.

51. Ibid.



In defending cognitive dissonance theory, Aronson argues that criticising the theory on the basis that it cannot be disproved, and so is valueless, indicates methodological failings, rather than theoretical deficiencies.<sup>52</sup> He further points out that critics who contend that "dissonance" is synonymous with "conflict" in decision-making theory, neglect the crucial fact that "conflict" occurs before the decision, dissonance afterward.

Although it has been demonstrated that people will resort to dissonance reduction techniques for a wide range of motives, including the attainment of consistency with peer groups or "significant others", successful functioning demands opinion that is, in some degree, "correct".<sup>53</sup> Therefore, in the long run, dissonance effects are seen as subordinate to the necessity to recognize error in matters basic to effective action in the environment. Aronson agrees with the earlier review by Chapanis and Chapanis<sup>54</sup> in concluding that cognitive dissonance theory is "not proven".

#### READINESS FACTORS

From infancy onward, people are continually refining and building their unique frameworks for assessing the potential significance of new sensory stimulation. In these terms, "readiness . . . consists of mastery of those simpler skills

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52. Ibid.

53. CHAPANIS, N.P. and CHAPANIS, A. 1964.  
Cognitive dissonance: five years later.  
Psychological Bulletin 61, 1-22.

54. Ibid.



that permit one to reach higher skills".<sup>55</sup> Or, as G.H. Lewis noted in 1879, "The new object presented to the sense, or the new idea present to thought must also be soluble in old experiences, be recognized as like these, otherwise it will be unperceived, uncomprehended."<sup>56</sup> Thus, readiness factors are mental attributes that predispose people to perceive from a characteristic point of view, and to observe certain patterns and relationships with greater facility than others. Some examples of what may be considered readiness factors are summarized below.

#### Mental set

On the basis of his experimental results, Allport defined "set" as a "preparatory or facilitating condition of the organism that precedes, accompanies, or may even outlast the completely executed overt behaviour of the act of perception".<sup>57</sup> As well as facilitating perception of the "set" object, or performance of the "set" action, this factor inhibits perception of other objects, or performance of other actions. Of two simultaneous stimuli, the observer perceives the one to which he is prepared to attend. Bodily needs, emotions, or personality traits may initiate sets. In the work situation, changes in rules or incentives may have the same effect. Allport feels that sets are

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55. BRUNER, J.S.  
Toward a theory of instruction.  
Cambridge, Massachusetts. Harvard University Press. 1967.  
P.29.
56. Quoted from: CANTRIL, H. Op. cit. P.469.
57. ALLPORT, F.H.  
Theories of perception and the concept of structure.  
London. Chapman and Hall, Ltd. 1955. P.213.

largely unconscious, and may lie dormant for long periods until invoked by a particular stimulus and context.

### Categorization

In order to avoid being overwhelmed by the great variabilities in the environment, people group or categorize observations. For example, human beings are capable of discriminating an estimated seven million different colours, all of which could be seen in a normal habitat during a few weeks.<sup>58</sup> In normal living, a rather coarse categorization suffices. Approximately twelve colours are customarily distinguished. However, in areas of special individual competency, extremely precise categories may be used, as when a lapidary investigates the colour of a diamond, or a doctor reads an x-ray plate. In short, "To categorize is to render discriminably different things equivalent, to group the objects, events, and people around us into classes, and to respond to them in terms of their class membership rather than their uniqueness".<sup>59</sup>

As well as simplifying the environment, categories allow rapid identification of familiar objects, and integration of unfamiliar ones, by successive application of sets of category criteria. In this way, no situation is entirely new because familiarity and expectancy are attained to the degree that categories can be applied. With grouping, general or superordinate relational systems can be constructed and fictional

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58. BRUNER, J.S., GOODNOW, J.J. and AUSTIN, G.A.  
A study of thinking.  
London. Chapman and Hall, Ltd. 1956. P.1.

59. Ibid.

groupings may be hypothesized as part of relational systems. This sort of process led to the observation of the planets Neptune and Pluto,<sup>60</sup> which "had" to exist if the accepted relational system of planets was to be maintained.

Sense cues from the environment could be grouped in many different ways. Categorization has been described as a process which begins with a creative definition of class criteria. Such a new definition would then be functionally tested, refined, and confirmed, or rejected.<sup>61</sup> Confirmed categories are the basis of object and social constancies.<sup>62</sup>

The "stereotype" is a particular kind of categorization, first applied to the social sciences by Walter Lippmann in 1922.<sup>63</sup> The original concept had four main elements. The stereotype was: simple rather than complex; erroneous rather than accurate; acquired through indirect rather than direct experience with the "reality" it was to represent; resistant to modification by new experience. With this meaning the term came to be used as a pejorative for "group concept".

This negative image of stereotypes was somewhat improved by Kleinburg's "kernel of truth hypothesis", according to which the overall amount of truth in a stereotype was held to be greater than the overall amount of error.<sup>64</sup> Continuing this

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60. Ibid. Pp. 11-15.

61. Ibid. Pp. 232-235.

62. CANTRIL, H. Op. cit.

63. LIPPMANN, W.  
Public opinion.  
London. George Allen and Unwin Ltd. 1922.

evaluation of the functional utility of stereotypes Hastorf and co-workers<sup>65</sup> concluded that, in person perception, the perceiver uses a core of general categories as a kind of coarse filter. Only when the subject varies significantly from the stereotype will he be differentiated as an individual.

#### Culture and language

Culture has been defined as "All historically created designs for living, explicit and implicit, rational, irrational, and non-rational, which exist at any time as potential guides for the behaviour of men".<sup>66</sup> It is through the operation of the perceptual processes that physical energies from the environment, mediated by the senses, are transformed into such behavioural guides. Or, as Triandis puts it, "When meaning is added to sensation the process is called perception".<sup>67</sup>

It is agreed that sensation is unaffected by culture. However, experimental evidence strongly indicates that the significance attached to sensation does vary with culture. For example, when pictures of bull fights and baseball games

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64. KLEINBERG, O.  
Tensions affecting international understanding: a survey of research.  
New York. Social Science Research Council. Bulletin 62. 1950.
65. HASTORF, A.H., RICHARDSON, S.A. and DORNBUSCH, S.M.  
The problem of relevance in the study of person perception.  
In TAGIURI, R. and PETRULLO, L. Op. cit. Pp. 54-62.
66. KLUCKHOHN, C. and KELLY, W.H. 1945.  
The concept of culture.  
In LINTON, R. (ed.)  
The science of man in the world crisis.  
New York. Columbia University Press. Pp. 78-101. P.97.
67. TRIANDIS, H. Op. cit. P.13.

were shown, at tachiscopic speeds, American subjects saw baseball and Mexicans saw bull fights.<sup>68</sup> The effect of cultural factors apparently increases with the ambiguity of the stimulus. Thus, it has long been held that, in matters of aesthetics and religion, cross-cultural variation will be greatest.<sup>69</sup>

Language is defined by Brown as ". . . nothing less than an inventory of all the ideas, interests, and occupations that take up the attention of the community".<sup>70</sup> If this definition is accepted, it is not surprising that skiers should have many terms for snow or that North Americans should have many different names for automobiles. The nub of the unresolved controversy between the "cloak" and "mold" theories of language turns on whether the term or category conditions the perception, or whether, as Brown suggests, the same perception could exist in any language-culture setting. In his view, concise terminology is a response to frequency of use, and the resultant desire for economic communication.

The major theoretical statement in the area of culture-language effects on world view is the so-called "Whorfian Hypo-

68. BAGBY, J.W. 1957.  
J. Abnormal and Social Psychology 54, 331-334.
69. TRIANDIS, H.C. 1963.  
Factors affecting employee selection in two cultures.  
J. Applied Psychology 47 (2), 89-96.
70. BROWN, R.W.  
Language and categories.  
In BRUNER, J.S., GOODNOW, J.A. and AUSTIN, G.A. Op. cit.  
P.311.

thesis". <sup>71</sup> The principal components of this theory, which both synthesized and inspired a great deal of research, are:

- a) all higher levels of thinking are dependent on language;
- b) the structure of the language one habitually uses influences the manner in which one understands his environment; the picture of the universe shifts from tongue to tongue. <sup>72</sup>

In evaluating this hypothesis Triandis <sup>73</sup> points out that most "Whorfian differences" occur in literature, and are not factors in the sciences. Furthermore, "the structure of connotative meaning" is broadly similar across cultures, indicating that category formation is the main area of cultural influence. Even in the supposedly culture-dominated area of aesthetics, certain pan-human factors have been found in artistic preference. <sup>74</sup>

The modern concensus appears to be that "cultural relativism has gone a bit too far". <sup>75</sup> Brown observes that intra-cultural variations are as great in our complex society as are cross-

- 71. CARROLL, J.B. (ed.)  
Language, thought, and reality - selected writings of Benjamin Lee Whorf.  
London. Chapman and Hall, Ltd. 1956. P.vi.
- 72. TRIANDIS, H. 1964. Op. cit. P.19.
- 73. Ibid.
- 74. MORRIS, C. 1957.  
Significance, signification, and painting.  
In LEPLIN, R. (ed.)  
The language of value.  
New York. Columbia University Press. Pp. 58-76.
- 75. BROWN, R.W. Op. cit.

cultural differences. People have the same basic physical and emotional mechanisms, and broadly speaking, the same objectives and problems. It is in the context of peculiar ecological situations that cultural-linguistic relativism arises. When a people are in persistent contact with one aspect of environment their language for dealing with it becomes elaborated. But this effect is no longer assumed to be "an awesomely powerful factor in cognitive functioning". <sup>76</sup>

#### Non-sensory figure-ground organization

Hebb defines nonsensory figure-ground organization as existing when "the boundaries of the figure are not fixed by gradients of luminosity in the visual field". <sup>77</sup> Perceived "safe" distances in driving and the learned ability to read x-ray plates are given as examples of this perceptual phenomenon. Hebb concludes that such standards of discrimination must derive from experience. A similar and frequently noted mechanism defines a range of culturally and individually acceptable separation distances for various social interactions. <sup>78</sup>

#### Affect

Response to a person who is attractive, liked, and admired will be quite different from the response to the same person if viewed with anxiety, hostility, or disapproval. The tendency

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76. FISHMAN, J.A. 1960.  
Behav. Sci. 5, 323-339.

77. HEBB, D.O. Op. cit. P.21.

78. WEINTRAUB, D.J. and WALKER, E.L. Op. cit. Pp. 75-76.

is to bestow desirable characteristics and favourable reaction in the former case, and their opposites in the latter. <sup>79</sup>

Experiments described by Horowitz indicate that hostile reactions can be aroused if a person is perceived as potentially reducing one's expected power. <sup>80</sup> Conversely, a subject perceived as likely to increase one's power is viewed with positive affect. Situations or objects that have been associated in one's experience with either success or failure could take on affective colouring in a similar way.

#### CONCLUSION

In general, perception in psychology is taken to be a process of interaction between man and surroundings, in which sense information is organized to specify behaviour. More circumscribed definitions are available, but these apply to particular research areas and often reflect doctrinaire beliefs.

Perception study is in an empirical stage, with emphasis on research and theory development on a number of fronts, and from a number of points of view. Entrenched positions on the empiricist-nativist controversy are no longer tenable. There is a tendency to recognize the limitations of the various theoretical stances, and to acknowledge possible complementarity. Theory development has been mainly by extrapolation of experimentally derived constructs to new, and often broader, contexts. This practice has generated new research areas and has contributed

79. WARR, P.B. and KNAPPER, C. Op. cit. Pp. 15-16.

80. HORWITZ, M.  
The veridicality of liking and disliking.  
In TAGIURI, R. and PETRULLO, L. Op. cit. Pp. 191-208.



to a concensus regarding the broad similarity underlying all perceptual processes.

"Perception" seems to have three main uses:

- a) as an uncommunicated internal experience;
- b) as a description of a perceptual experience, either by the perceiver or an observer;
- c) as a theoretical structure to explain the processes

involved in attributing significance to sense experience.

The meanings attached to these uses are not constant. A descriptive statement in traditional S-R psychology is confined to statements about objectively observable, physical responses, while Gestaltists apply this label, as well, to introspective evidence. The meaning given to perception as a theoretical construct varies with the research focus. Structuralists, i.e. those working to isolate elementary components of perception, tend to use rigidly controlled laboratory experiments with relatively simple stimuli. The theoretical explanation here will not be as complex as in the Functionalist approach, where subjects are studied in interaction with their normal environments. In the latter case, such complicating variables as learning, motivation, attitudes, needs, and social pressure become involved.

There is apparent general agreement that a principal function of perception is to exclude irrelevant sense information. This is accomplished by a learned, unconscious evaluative system in which categories, stereotypes, base levels, sets, and the like are used to obstruct the particular and admit the general, in order to maximize the significance of sensory input.

On the basis of this sample of perception theory in psychology, it appears that there is no ready-made and all-encompassing formulation that is obviously suitable for application to the kinds of problems with which human geographers are concerned. Elements of some of the theories outlined above, and of other psychological approaches and techniques, are already familiar to geographers as part of their study of "environmental perception". Which ideas are these? How have they been applied to geographical problems? The following chapter will attempt to trace developmental themes in behavioural geography.

## Chapter 3.

### BASIS IN GEOGRAPHICAL RESEARCH

The main concern in this introduction to the literature on behavioural research in geography is to trace how and when concepts and approaches basic to this study came into geographical thought. An historical approach is therefore adopted in evaluating the influential schools that developed.

#### BACKGROUND - TO 1960

The germ of what has been called psychological geography - the geography of men's minds - has been present in the discipline for many years. Trowbridge's investigation of mental maps<sup>1</sup> showed the negative effect of unique and individual errors in orientation regarding far distant places on efficient local navigation. Also in the early twentieth century, Cvijic made a somewhat deterministic case for the study of geographical parameters as causes of variations in regional character:

"We consider, therefore, an important aim of geography to be the determination of the psychological character of the population in different geographical regions and to indicate the part which geographical conditions took in the formation of the character."<sup>2</sup>

During the same period, other environmental determinists, such as Semple and Huntington, were also strongly emphasizing the power

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1. TROWBRIDGE, C.C. 1913.  
On fundamental methods of orientation and imaginary maps.  
*Science* 38, 888-897.
  2. CVIJIC, J.  
*Le Peninsule Balkanique, geographie humaine*.  
Paris. Librairie Armand Colin. 1918.  
Quoted in: CAMPBELL, R.D. 1968.  
Personality as an element of regional geography.  
*Annals, Assoc. Am. Geog.* 58, 748-759. P.749.

of the physical environment to influence men's actions and world view.

Later writers stressed the wide range of possible responses by different groups to essentially similar landscapes. Harlan Barrows pointed to the habits and attitudes of the people as important determinants of any land use system.<sup>3</sup> In his scheme, natural, built, and social environments were seen to interact to produce a unique balance characterizing, for a given time, the life of a people in their particular physical setting. Carl Sauer wrote in similar vein on "the phenomenology of landscape", a living system of people and land seeking equilibrium.<sup>4</sup> Erich Zimmerman demonstrated that one culture's impediment may be another's resource.<sup>5</sup> In this way the physical environment could be considered as initially "neutral stuff" to which value was imparted by culture.<sup>6</sup>

In defining "geosophy", J.K. Wright conceived the world as a patchwork of "terra incognita", most areas known to some, but none known to all.<sup>7</sup>

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3. BARROWS, H.H. 1923.  
Geography as human ecology.  
Annals, Assoc. of Am. Geog. 2 (13), 1-14.
  4. SAUER, C. 1925.  
The morphology of landscape.  
In LEIGHLY, J. (ed.)  
Land and life: a selection from the writings of Carl  
Ortewin Sauer.  
Berkeley. The University of California Press. 1967.
  5. ZIMMERMAN, E.  
World resources and industries.  
New York. Harper. 1933.
  6. WHITTLESEY, D. 1945.  
The horizons of geography.  
Annals, Assoc. Am. Geog. 35, 1-36.

The geosophist's task, as Wright saw it, was to study geographic knowledge from any and all points of view, incorporating all shades of opinion, bias, motivation and compulsion; singly and in combination, correct and incorrect, present and historical. Essential to this task was increased interdisciplinary cooperation, and the judicious use of "imagination" to supplement traditional "scientific" methods. Wright's work was another step in the progressive effort to incorporate "psychological man" into the already familiar concepts of rational man and economic man.

By the early nineteen-fifties the milieu of geographic thought admitted a new research perspective based upon the interactions of the functioning individual with his particular environment. This approach involved the effects of shared and personal cultures and thus a major aim was to specify for research the collage of value systems, language, motivation, and beliefs that in its unique totality defined for each individual, an erroneous or accurate personal world view - a personal geography. Research in this "new" geography was characterized by greater emphasis on intuition and by the borrowing of techniques and concepts from other disciplines.

The first of these major annexations was made by Kirk,<sup>8</sup> who reinterpreted the man-land relationship in terms of "behavioural environment". He contended that this approach

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7. WRIGHT, J.K. 1947.  
Terra incognita: the place of imagination in geography.  
Annals, Assoc. Am. Geog. 37 (1), 1-15.
  8. KIRK, W. 1952.  
Historical geography and the concept of the behavioural environment.  
Indian Geographical Society, Silver Jubilee.  
Souvenir Volume. Pp. 152-160.

could add values to facts, and could focus on action and process, as well as on simple distribution. He sought the "enunciation of law" for human behaviour. Following the psychology of Wolfgang Kohler, Kirk argued that the mind tended to organise incoming sense information according to memories of personal past experience which might be culture-dependent or individually unique. The conscious ability to vary perceived figure-ground relations was taken as evidence of a "self" factor in the organization of sense experience. A familiar drawing by Toulouse Lautrec (Figure 3-1) was given as illustration of how conscious figure-ground manipulation might be made. In Kirk's hypothesis the totality of the observer and his surroundings is termed the "psycho-physical field" or "phenomenal environment" (Figure 3-2).

"If "A" represents the physical environment including both the physical and cultural landscapes, and "C" represents the physical human group or individual present in the environment, the physical state of "C" will depend in part on the character of "A", but any action of "C" in this environment will commence in the relief of stresses in an internal environment "B" which are as much the product of the group culture "D" as the act of observation of the physical environment. This internal environment we may call the "Behavioural Environment" and in this environment the gap is closed between Mind and Nature." 9

Three books of this period, although not strictly geographical, have had strong influence on behavioural research in geography. The first of these, Ken Boulding's monograph on "the image",<sup>10</sup> may be interpreted as a description of the components of Kirk's work specifically. An image, in Boulding's sense, is a concept

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9. Ibid. P.159.

10. BOULDING, K.  
The image.  
Ann Arbor. University of Michigan Press. 1956.

which may be unique or shared; it must have a spatial and temporal location and it may stand in systematic relation to other images. Values and emotion both colour these concepts, which may be available for recall depending on whether they reside in the conscious, unconscious, or subconscious mind. The certainty or clarity of images varies with the strength of belief in their correspondence to some external "reality".

A second major work of this period is H.A. Simon's "Models of Man".<sup>11</sup> He examines the inadequacies of economic man as a theoretical tool, and concludes that psychological properties may outweigh the assumed desire for maximum gain. In his view, when faced with the complexity of the real world and a limited mental capacity, men resort to simplifying models and subjective probabilities based on personally accepted "givens". Complexity can also be reduced to manageable proportions by adoption of a clearly specified role which one is capable of learning because of its limitations. Both game theory and statistical decision theory are held by Simon to be "wrong-headed" and unable to deal with decision-making by real people in a real world, since they assume "virtual omniscience and unlimited computational power". As an alternative Simon suggests the "satisficing concept", whereby one does not evaluate all possibilities or even seek to "maximize" benefit from a given decision; rather a person seeks a course of action that is "good enough". It has been suggested by Harvey that this is really an "optimizing" theory, but with

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11. SIMON, H.A.  
Models of man: social and rational.  
New York. John Wiley and Sons. 1957.



reference to non-economic values.<sup>12</sup>

The third highly influential work, by W. Firey,<sup>13</sup> put forward a model of resource use embodying cultural, technological and physical environmental constraints. (Figure 3-3) In this, "P" represents the set of resource processes that are possible in a given physical setting; "C" is the set which are "culturally available" for a given population; "A" is the set which are adoptable; "E" is the set which are efficient, and "G" the set which are gainful. Firey suggests that a complex and individualistic system of lenses and focuses determines what men see, and therefore what men do, in their environments.

Publications by White,<sup>14</sup> Lowenthal,<sup>15</sup> and Lynch<sup>16</sup> in the early sixties may be construed as the stimuli producing a spate of behavioural research in geography. White outlined three

12. HARVEY, D.  
Conceptual and measurement problems in the cognitive-behavioural approach to location theory.  
In COX, K.R. and GOLLEDGE, R.C. (eds.)  
Behavioural problems in geography: a symposium.  
Evanston, Ill. Northwestern University. Studies in geography. No. 17. Pp. 35-67. P.48.
13. FIREY, W.  
Man, mind, and land: a theory of resource use.  
Glencoe. The Free Press. 1960.
14. WHITE, G.F. 1961.  
The choice of use in resource management.  
Natural Resources Journal 1 (1), 23-70.
15. LOWENTHAL, D. 1961.  
Geography, experience, and imagination: towards a geographical epistemology.  
Annals, Assoc. Am. Geog. 51 (3), 241-260.
16. LYNCH, K.  
The image of the city.  
Cambridge, Massachusetts. M.I.T. Press. 1960.



methods of assessing resource use decisions: theoretical possibilities; practical possibilities; managerial predispositions. In this scheme a "resource manager" could be anyone controlling the use of some natural resource, even if only by his physical presence. White pointed out the need to evaluate such managers' attitudes as they impinged on the relationship between decisions taken and "objective" decisions in the same situation. Under White's aegis research on hazard zone occupance, differential resource evaluation, and managerial attitudes expanded rapidly over the next ten years.

David Lowenthal introduced a wealth of "new" ideas, principally from psychology. He reordered these, and geography's scant contemporary perception theory, in terms of processes by which meaning is assigned to sense experience, pointing out that each person "carries with him over into every perceptual situation ... his characteristic sensory abilities, intelligence, interests and temperamental qualities ...". He contended that individual world views would be, to some extent, unique because of this diversity in perceptual "set" and basic capacity, and also because of each person's necessarily distinctive time/space location. Lowenthal observed that, for survival, "the picture of the world in our heads" must conform to some extent "with the world outside".

Many of the tools necessary for the building of these pictures which accord significance to personal experience are seen to derive from one's cultural setting. From earliest childhood society's language, stereotypes, categories, and symbols are transmitted, at first by the family and later by other members of the group.

Once learned these organizational and expressive patterns, though mutable, resist change in response to new information. Fear, hope, and belief are also suggested by Lowenthal as influences on the meaning of sense information. "Metaphysical assumptions, from original sin to the perfectability of man, not only colour, but shape the shared picture of the world." Cross-cultural variations in "world picture" are also emphasized in Lowenthal's work particularly regarding means of orientation, object and colour perception, and territoriality. He further notes that different cultures assign symbolic values in markedly different ways. For example, the distinction between left and right hands in some cultures of the East has no counterpart in Western ways.

Kevin Lynch adapted Boulding's "image" idea for his investigation of the visual impressions which people have as they move through certain built environments.<sup>17</sup> He wished to isolate the images that would be striking for most people, so that these might be meaningfully incorporated in planning generally and in road design in particular. The effect of his work in geography was to trigger off a renewed interest in mental mapping. At this time too, Kelly's personal construct theory<sup>18, 19</sup> and

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17. APPLEYARD, D., LYNCH, K., AND MYER, J.R.  
The view from the road.  
Cambridge, Massachusetts. M.I.T. Press. 1964.
  18. KELLY, G.A.  
The psychology of personal constructs.  
Norton. Volumes 1 and 2. 1955.
  19. BANNISTER, D. and FRANSELLA, F.  
Inquiring man - the theory of personal constructs.  
Harmondsworth, Middlesex. Penguin Books. 1971.

Money-Kyrles' work on "man's picture of his world" <sup>20</sup> provided impetus in this direction from other disciplines.

These authors, White, Lowenthal and Lynch, seem to summarize the theoretical position of behavioural geography at the beginning of the sixties. From this point, a distinctive "school" of researchers followed Gilbert White, and another group of "image" researchers emerged in the Kevin Lynch - Kenneth Boulding tradition. Lowenthal's influence may be seen in all of these, but not with the same distinctive imprint of the others. The remaining part of this review will look at the work inspired by White and Lynch, then turn to stochastic models and behavioural theories, as two other areas of geographical work involving perception, in some degree.

#### THE INFLUENCE OF GILBERT WHITE - NATURAL HAZARDS RESEARCH

Natural hazards research began with studies of human response to life on riverine floodplains. Roder on the Topeka, <sup>21</sup> and Burton on the Little Calumet <sup>22</sup> used face-to-face questionnaire interviews with potential victims of flooding, some of whom lived in each of defined "high", "medium", and "low" risk areas. A "special knowledge" group composed of bankers and real estate agents was included in the sample to ascertain likely effects of

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20. MONEY-KYRLE, R. 1961.  
Man's picture of his world.  
London. Gerald Duckworth and Co. Ltd.
21. RODER, W.  
Attitudes and knowledge on the Topeka flood plain.  
In WHITE, G.F. (ed.)  
Papers on flood problems.  
Chicago. University of Chicago Department of Geography.  
Research Paper No. 70. 1961. Pp. 62-83.
22. BURTON, I.  
Invasion and escape on the Little Calumet.  
In WHITE, G.F. (ed.)  
Papers on flood problems.  
Chicago. University of Chicago Department of Geography.  
Research Paper No. 70. 1961. Pp. 34-92.

inundation on property values. These early studies concluded that residents' knowledge about flood protections was not linked to their expectation of future flooding. Information that was available on the degree of flood risk seemed to be received mainly by the higher education groups. On this basis it was hypothesized that public education efforts such as the Geological Survey's then forthcoming map of flood risk zones would impart little new knowledge to the majority of risk area residents, and indeed, more accurate knowledge of the flood threat might only speed up migration and thus, too, the more rapid deterioration of community structures and property values in the area.

In response to a suggestion by Lorne Thornthwaite following the Atlantic storm of March 6 and 7, 1962, this line of investigation was extended from riverine to coastal flood plains,<sup>23</sup> in a study of reactions to storm and flood threat in fifteen sections of the Atlantic seaboard of the U.S.A. One of the conclusions was that residents tried to minimize the uncertainty of flood/storm incidence by averring that storms had a fixed cyclical recurrence, or by affirming personal invulnerability, even when admitting that storms might occur in future.<sup>24, 25</sup> The authors

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23. BURTON, I., KATES, R.W., and SNEAD, R.E.  
The human ecology of coastal flood hazard in Megolopolis.  
Chicago. The University of Chicago Department of Geography.  
Research Paper No. 115. 1969.
  24. KATES, R.W. 1967.  
The perception of storm hazard on the shores of Megolopolis.  
In LOWENTHAL, D. (ed.) Environmental perception and behaviour.  
Chicago. University of Chicago Department of Geography.  
Research Paper No. 109. Pp. 60-69.
  25. BURTON, I. and KATES, R. 1964.  
The floodplain and the seashore - a comparative analysis  
of hazard zone occupance.  
The Geographical Review 54 (3), 366-385.

pointed out that such attitudes were reinforced by each escape from damage in a storm or flood, and were seen to be more prevalent among older respondents.

Others tried to minimize uncertainty by ignoring risk, or by denying that natural phenomena could be understood and placing their faith in a divine power. By a similar mechanism, some were found to place inordinate faith in flood control works, even though these were located downstream, or were of dubious efficacy. In general, rural flood plain occupants were found to have a more accurate knowledge about the hazard than their urban counterparts, but even they tended to underestimate the frequency and severity of flooding.

Many respondents in both riverine and coastal situations noted positive locational factors of their area including: recreational opportunity; easy building and waste disposal; and historical advantages of transport and shelter in valleys. These apparently acted as countervailing factors in their subjective risk evaluations.

An hiatus was observed between the decision processes of ordinary residents and those of the "technical scientific community". The latter tended to be better suited "by their training" to view nature as neutral in men's affairs, and to deal comfortably with high levels of uncertainty. Despite this, the experts did not agree on specific risk assessments, due to differences in such matters as personal experience, training, degree of vested interest, personality, affect and ignorance. <sup>26</sup>

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26. BURTON, I. and KATES, R.W. 1964.  
The perception of natural hazards in resource management.  
Natural Resources J. 3 (3), 412-441.

The authors further pointed out that the ordinary citizen, cut off from unequivocal expert advice might well fall back upon his subjective views of the benevolence or malevolence of nature to aid in assessing risks. This effect, they felt, might explain the observed response disparity between "trained" and untrained hazard perceivers.

Burton and Kates continued their generalization to other "natural hazards", i.e. "those elements of the physical environment harmful to man and caused by forces extraneous to him".<sup>27</sup> They postulated that awareness of risk depended upon the degree to which resource use was disrupted; the frequency of disruption; and the directness of personal involvement.

As this research line developed psychological factors, such as "attitudes" and "personality"<sup>28</sup> were increasingly invoked to explain observed or inferred decision-making processes.<sup>29</sup>

White<sup>30</sup> noted that it was not only the personal attitudes of the decision-maker that affect such decisions, but also what he thought attitudes of others ought to be. Such attitudes, defined in terms of "preference", were seen to derive from the individual's

27. Ibid.

28. SCHIFF, M.R.  
Some theoretical aspects of attitudes and perception.  
Toronto. Natural Hazard Research. Working Paper No. 15.

29. KATES, R. 1970.  
Natural hazard in human ecological perspective: hypotheses and models.  
Toronto. Natural Hazard Research. Working Paper No. 14.

30. WHITE, G.F.  
Formation and role of public attitudes.  
In JARRETT, H. (ed.)  
Environmental quality in a growing economy.  
London. The Johns Hopkins Paperbacks. 1971. Pp. 105-127.

experience with the environment, the decision situation, his perception of his role, and his competence in dealing with complexity. Methods of studying attitudes of hazard zone occupants, to this point, included objective risk assessment, inference from observed adjustments, interviews with occupants, and theorizing from these about decision-making mechanisms. In addition, White suggested that attitudes might be inferred from a scholarly examination of writing about the environment, content analysis of newspapers, and from specially constructed experiments. <sup>31</sup>

Saarinen adapted the methodology of Burton, Kates, and Roder for his study of drought and storm perception in the Great Plains. <sup>32</sup> Sims and Bauman took a similar approach in their investigation of "coping styles" in tornado-prone areas of the U.S.A. <sup>33</sup> Each of these studies incorporated a further technique from psychology: the former using the Thematic Apperception Test; the latter sentence stem completions. The influence of White's methodological suggestions can be seen in other studies which followed.

Sonnenfeld used the "experimental" approach in his work with graded pairs of landscape slides presented, in a standard

31. Ibid. Pp. 112-118.

32. SAARINEN, T.F.  
Perception of the drought hazard on the Great Plains.  
Chicago. University of Chicago Department of Geography.  
Research Paper No. 106.

33. SIMS, J.H. and BAUMANN, D.D.  
The tornado threat: coping styles of the North and South.  
Paper presented to: UNESCO Seminar on Natural Hazards.  
Godollo, Hungary. August 4 - 9, 1971.



setting,<sup>34</sup> to Arctic residents. Saarinen and Cooke<sup>35</sup> modelled their multi-hazard study in Tucson on Van Arsdol's work in Los Angeles,<sup>36</sup> as well as on the natural hazards approach of comparing subjective with objective risk assessment.

In 1968, the Natural Hazards Research working papers were instituted.<sup>37</sup> This series provides methodological,<sup>38, 39, 40</sup> bibliographical,<sup>41, 42, 43</sup> and coordinational information<sup>44</sup> as background for a collaborative study of a wide range of environmental threats on global, national, and case-study scales.<sup>45</sup>

34. SONNENFELD, J.  
Environmental perception and adaption level in the Arctic.  
In LOWENTHAL, D. (ed.)  
Environmental perception and behaviour.  
Chicago. University of Chicago Department of Geography.  
Research Paper 109. Pp. 42-59.
35. SAARINEN, T.F. and COOKE, R.U.  
Public perception of environmental quality in Tucson, Arizona.  
Occasional Papers. Department of Geography, University College.  
London. 1970.
36. VAN ARSDOL, M.D., SABAGH, G., and ALEXANDER, F. 1964.  
Reality and perception of environmental hazards.  
J. of Health and Human Behaviour. Pp. 144-153.
37. BURTON, I., KATES, R., and WHITE, G.  
The human ecology of extreme geophysical events.  
Toronto. Natural Hazard Research. Working Paper No. 1. 1968.
38. BARKER, M. and BURTON, I.  
Differential response to stress in natural and social environments: an application of a modified Rosenweig picture - frustration test.  
Toronto. Natural Hazard Research. Working Paper No. 5. 1969.
39. GOLANT, S. and BURTON, I.  
Avoidance - response to the risk environment.  
Toronto. Natural Hazard Research. Working Paper No. 6. 1969.
40. GOLANT, S. and BURTON, I.  
The meaning of a hazard-application of the semantic differential.  
Toronto. Natural Hazard Research. Working Paper No. 7. 1969.
41. Toronto. Natural Hazard Research. Working Paper No. 2.
42. Toronto. Natural Hazard Research. Working Paper No. 4.
43. Toronto. Natural Hazard Research. Working Paper No. 9.
44. Toronto. Natural Hazard Research. Working Paper No. 16.



Under the coordination of the Man and Environment Commission of the International Geographical Union, observations have been made on human response to different hazards in many countries of the world. These studies used the same basic questionnaire in an effort to achieve maximum comparability of data.<sup>46</sup>

#### THE INFLUENCE OF KEVIN LYNCH

Kevin Lynch applied certain aspects of the theories which Kelly discussed in terms of "personal constructs"<sup>47</sup> and Boulding considered in his "image" concept.<sup>48</sup> Lynch said:

"a workable image requires first the identification of its recognition as a separable entity. This is called identity, not in the sense of equality with something else, but with the meaning of individuality or oneness. Second, the image must include the spatial or pattern relation of the object to the observer and to other objects. Finally this object must have some meaning for the observer, whether practical or emotional."<sup>49</sup>

Lynch sought to identify urban forms that were "legible", i.e. that had a high probability of evoking a strong image in any given observer. His interviews in Boston, Jersey City, and Los Angeles collected descriptions of what respondents felt were noteworthy sites in their city, as well as their recollections of what one would see while travelling on certain routes.

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- 45. BLACKSELL, M. 1971.  
IGU: Commission on Man and Environment.  
Area, 3 (4), 220-221.
  - 46. An interim report of this project is forthcoming as a proceedings volume of the Man and Environment Commission Symposium held at Calgary, July 27 - 30, 1972.
  - 47. BANNISTER, D. and FRANSELLA, F. Op. cit.
  - 48. BOULDING, K. Op. cit.
  - 49. LYNCH, K. Op. cit.

Respondents were asked to produce a sketch map of their city.

The latter technique is noted by Saarinen as "essentially a projective test which allows for and demands a maximum of structuring by the subject".<sup>50</sup>

From this information Lynch was able to confirm his hypothesis that people with broadly common culture and sensory apparatus, sharing the same physical setting, would generally focus upon the same elements of that setting. Or as Lynch put it:

"There seems to be a public image of any given city which is the overlap of many individual images. Or perhaps there is a series of public images, each held by some significant number of citizens. Such group images are necessary if an individual is to operate successfully within his environment and to cooperate with his fellows".<sup>51</sup>

These focal points or "city images" were classified as "paths, edges, districts, nodes and landmarks".

#### Images and road design

In later work Lynch and his co-workers focussed upon the aesthetic experience of motoring on modern highways. Pushkarev noted that vision was the operative sense both for the traveller and for the stationary observer of the roadway.<sup>52</sup> It was, therefore, necessary to position the road to fit in a pleasing way into the landscape yet at the same time provide a pleasing

50. SAARINEN, T.F.  
Perception of environment.  
Washington, D.C. Commission on College Geography.  
Assoc. Am. Geog. 1969. P.15.

51. LYNCH, K. Op. cit. P.46.

52. PUSHKAREV, B.  
The aesthetics of freeway design.  
Landscape 10 (2), 7-15. Winter 1960-61.

experience for the driver. The former involved a matter of aesthetic judgement by the designer; the latter required an understanding of space perception in a moving automobile. As speed increases the driver's concentration becomes greater and focuses further out in front of the vehicle. This causes a loss of peripheral and foreground detail and a deterioration in spatial orientation. A "busy" roadside cluttered with signs or crowded with buildings may hurt the driver's eyes or cause dangerous distraction. If high speed travel is to be pleasant the road itself must be aimed at the desired view so it is in front of the driver and does not break his continuity of vision.

Appleyard and others elaborated these ideas to suggest that roadways and their margins be designed to give continuity of experience that was "legible" at varying speeds, and from either direction.<sup>53</sup> At the same time there had to be sectional demarcation so that drivers could feel progress and avoid boredom. Visual continuity had also to be held over each section, since some journeys would be short. Their ideas were for a sophisticated "burma shave"<sup>54</sup> tableau which would teach travellers something of the countryside through which they were passing, and, at the same time, maximize safety by keeping drivers alert, with their attention focused firmly on the road. Snow shared this concern for the quality of driving experiences, and emphasized the anti-social nature of travel on modern, high-speed

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53. APPELYARD, D., LYNCH, K., and MYER, J.R. Op. cit.

54. A sequence of spaced road signs, each of which contributes part of a message; e.g. Buy . . . Burma . . . SHAVING . . . CREAM.

roads. 55

Images and areal definition

Subsequent researchers, inspired by Lynch, adapted and extended his methodology to explain interpersonal differences in areal images by reference to such observer attributes as socio-economic level, personal past experience, life stage, and the influence of idealized concepts. An example of the latter effect, wherein a personal standard is used to assess whether a given scene fits the inclusion criteria, is Lucas' comparison of the "wilderness" definitions given by users of the Boundary Waters Canoe Area with their travel patterns while using the park. 56 A systematic variation in boundary position was observed, in which the "canoeists" were most selective, designating only a small, unfrequented core area of the park as "wilderness". "Motor-canoeists" were less demanding and included a larger area. "Wilderness" for the power-boat enthusiast began almost at the car park. These groups held demonstrably different ideas about what could be allowed in a "wilderness", and yet, shared a broadly similar concept insofar as they came to the same place to find it.

Saarinén applied similar techniques in his 1964 interviews with a total of 72 "workers" and students in Chicago. 57 He found that differences in sketch maps of the Loop area of the city were

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55. SNOW, J.T. 1967.  
The new road in the United States.  
Landscape 17 (1), 13-16.

56. LUCAS, R.C. 1964.  
Wilderness perception and use: the example of the Boundary Waters Canoe Area.  
Natural Resources Journal 3 (3), 394-411.

related to the respondent's usual direction of entrance to the sector, and to his reasons for going there. Frequented buildings and areas were more likely to be included. Maps tended to emphasize the grid street pattern and to smooth out any deviation from it. On the whole, workers delimited a smaller, more detailed Loop than did students who were relative newcomers and tended to note landmarks.

Klein's respondents in Karlsruhe (746) and Waldstadt (372) were asked to sort playing cards naming streets and buildings according to whether they were or were not in the town centre.<sup>58</sup> This method avoided problems of varying subject familiarity with maps, but at the same time placed constraints on response freedom. Results indicated that the inhabitants of the core area defined it in the most constricted terms. This was consistent with Heinemeyer's conclusion that, in Amsterdam, "the greater the distance between home and core the greater the distance between (town-centre) gate and core".<sup>59</sup> Young people, newcomers, and the upper classes in Klein's sample tended to give "narrow"

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57. SAARINEN, T.F. 1964.  
Image of the Chicago Loop.  
Unpublished paper reported in:  
SAARINEN, T.F.  
Perception of environment.  
Washington, D.C. Commission on College Geography.  
Assoc. Am. Geog. 1969.
58. KLEIN, H.J.  
The delimitation of the town-centre in the image of its citizens.  
In Urban core and inner city.  
Leiden. E.J. BRILL. 1967. Pp. 286-306.
59. HEINEMEYER, W.F.  
The urban core as a centre of attraction.  
In Urban core and inner city.  
Leiden. E.J. BRILL. 1967. Pp. 82-99.

definitions, while the largest town centres were attributed by the lower classes, and by tradesmen. The latter group's response was explained as their stretching the core to encompass wholesale suppliers located on the outer ring of the central business district, because these were their most frequent "downtown" destination. A similar stretching was noted as all groups distorted the town-centre toward their own neighbourhoods without changing its size. Focal points in the town-centre were markedly different for old and young respondents.

Klein offers two general comments on his study. First, that the distortion of town-centre toward the home neighbourhood may be a factor in city growth; and secondly, that images of the city are built up by the frequency of personal visual experience in the area. The latter point agrees with Prokop's assertion that, "the boundaries of spatial images could be determined almost socio-metrically by the range of social contacts or interactions of the image-holders", <sup>60</sup> and is also confirmed by Sievert's developmental investigation of the images of the Berlin held by students from beginning school through university. <sup>61</sup> Lee was also concerned with the areal extent of neighbourhood concepts. He used the "draw-a-line-around-your-neighbourhood" approach with

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60. PROKOP, D.  
Image and functions of the city.  
In Urban core and inner city.  
Leiden. E.J. BRILL. 1967. Pp. 22-34. P.25.

61. SIEVERTS, T.  
Perceptual images of the City of Berlin.  
In Urban core and inner city.  
Leiden. E.J. BRILL. 1967. Pp. 282-285.

219 subjects in "a small city" (Cambridge).<sup>62</sup> Although shape and content varied, the area included in these "personal neighbourhoods" was relatively constant despite large differences in population density. This suggested that neighbourhoods were defined more by amount of territory than by size of population.

Eyles used a similar approach with 100 residents of the Highgate Village area of London.<sup>63</sup> His findings reinforced some of Klein's earlier conclusions, for example, respondents tended to "pull" the desirable "Village" area toward their homes, and long-term residents tended to define in more exact and areally constricted terms. In most cases the image was found to be most definite near the home area.

These studies of small scale areal concepts bear tentative conclusions that:

- a) one's picture of an area depends greatly on one's functional experiences with it;
- b) one tends to distort the location of subjectively desirable areas towards one's home;
- c) distances toward a city centre are perceived as less than objectively equal distances in other directions;
- d) functional intent, and age, influence the part of an area that will be emphasized in one's personal image.

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62. LEE, T. 1968.  
Urban neighbourhood as a socio-spatial scheme.  
Human Relations 21, 241-267.

63. EYLES, J.D.  
The inhabitants' images of Highgate Village (London).  
London School of Economics and Political Science, Graduate  
Department. Discussion Paper No. 15. 1968.



## THE GROWTH OF IMAGE GEOGRAPHY

Image and distance

The city centre was recognized as a distorting factor in perceived distance by Brennan,<sup>64</sup> insofar as he postulated that housewives would use the shopping area in the direction of the town centre, even when this was not the nearest to their home in actual distance. Lee, in apparently verifying "Brennan's Law", came to wonder if it might be a special case of a more general distortion of urban distance because of the attraction of the city core area.<sup>65</sup> A sample of 166 Dundee students was asked to estimate the distance to each of eleven pairs of destinations. In each pair, one location lay toward the city centre and the other toward the outside of the city. Although both distances were objectively equal for each pair, the subjects consistently estimated distances in the downtown direction as shorter. Once again "Brennan's Law" was sustained.<sup>66</sup>

The work of Brennan and Lee was foreshadowed by an unpublished study by Watson in Hamilton, Ontario, during the late 1930's.<sup>67</sup>

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64. BRENNAN, T.  
Midland city.  
London. Dobson. 1948.  
Quoted from: LEE, T. 1962.  
"Brennan's Law" of shopping behaviour.  
Psychological Reports 11, 662.
65. LEE, T. 1962.  
"Brennan's Law" of shopping behaviour.  
Psychol. Reports 11, 662.
66. LEE, T. 1970.  
Perceived distance as a function of direction within the city.  
Environment and Behaviour 2, 40-51.
67. WATSON, J.W.W.  
Measuring mental miles.  
Lecture. University of Edinburgh Department of Geography.  
October 31, 1972.



In this project estimates of distances between neighbourhoods of various social status were obtained. Respondents were found to under-estimate their separation from neighbourhoods with the same social standing as their own, and to over-estimate physical distances to socially distant neighbourhoods. Stea's work of some thirty years later tended to support Watson's findings.<sup>68</sup> In his conceptual model based on "distance", "bearings", and "turns", Stea sought to elaborate the usual map drawings and distance estimates with background information on journey frequency and mode of transport. His study suggested that the affective aura of the destination would influence estimated distances. That is, distances to desirable places would be under-estimated; distances to undesirable places would be over-estimated.

#### Image and symbolic stereotypes

Although such ideas of subjective distortion in spatial images had been recognized since Trowbridge's work on the effects of erroneous mental maps on personal orientation, these were not a focus in geographic research until the work of Gould<sup>69, 70</sup> and

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68. STEA, D.  
The measurement of mental maps: an experimental model for studying conceptual spaces.  
In COX, K.R. and GOLLEDGE, R.G. (eds.)  
Behavioural problems in geography: a symposium.  
Northwestern University. Studies in Geography No. 17.  
Pp. 228-253. 1969.
69. GOULD, P.R.  
On mental maps.  
Michigan Inter-University Community of Mathematical Geographers, Discussion Paper No. 9. Ann Arbor. Department of Geography, University of Michigan. 1966.
70. GOULD, P.R. 1967.  
Structuring information on spatio-temporal preferences.  
Journal of Regional Science 7, 259-273.

White.<sup>71</sup> They investigated the different preferences people had for areas, even though they might never have been there. Working with "school leavers" in twenty-three areas of the U.K.,<sup>72</sup> they used the following methods: "With the base map in front of them, the pupils were asked to order their own, quite individual notions of residential desirability on the assumption that they would have an absolutely free choice to live where they wished . . ."

From this basic data, a "preference surface" was constructed for each school using principal components analysis. Those of Newcastle and Inverness (Maps 3-1 and 3-2) are included here as representative of overall findings. A decrease in residential preference from south to north was in all cases accompanied by a high preference for the home area, which created a more obvious "local dome" in the higher latitudes. (Map 3-1) Familiar holiday spots, such as the Lake District, frequently stood out as plateaus while a marked decline in residential desirability occurred at the Scottish border, as perceived from both sides. Little interpretation of the findings was offered, except that "information flows" might be the key to an explanation at some future time.

The effect of such information flow was investigated by

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71. WHITE, R.  
The measurement of spatial perception.  
Bristol. University of Bristol Department of Geography.  
Seminar Paper Series A, No. 8. 1967.
72. GOULD, P.R. and WHITE, R.R. 1968.  
The mental maps of British school leavers.  
Regional Studies 2, 161-182.

Haddon.<sup>73</sup> He asked his geography students to describe their impressions of a number of countries that had recently been studied in class. These responses were combined into amalgam "snapshots" of the images or stereotypes which the countries evoked. For example, "America is different. America is a country of remarkably developed, highly polished young women, and oddly garbed, criminally inclined young men travelling at great speed in monstrous cars along super highways from one skyscraping city to the next; the very biggest cars contain millionaires with crew-cuts; everyone is chewing gum." Disconcertingly for the geography master, these descriptions bore little relation to the formal lesson material and seemed to focus more on people and life styles popularly depicted by the cinema, television, magazines and books.

A number of researchers have been concerned with the power of literary descriptions in crystallizing regional concepts, such as those Haddon discovered. Among the first of these was Darby who commented on the impressions of Wessex given by the writings of Thomas Hardy.<sup>74</sup> In the same vein Strauss exhaustively inventoried literary inputs to city and area images for the U.S.A.<sup>75, 76</sup> In this scheme Chicago was composed of

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73. HADDON, J. 1960.  
A view of foreign lands.  
Geography 45, 286-289.
74. DARBY, H.C. 1948.  
The regional geography of Thomas Hardy's Wessex.  
Geog. Rev. 38, 426-443.
75. STRAUSS, A.L. 1961.  
Some varieties of American urban symbolism.  
In STRAUSS, A.L. (ed.)  
The American city.  
London. Allen Lane. The Penguin Press. 1968. Pp. 19-35.

stock-yards and slaughter-houses, and peopled by gangsters; Reno was the divorce centre; Las Vegas, the gambling capital, and so on. More recently, Spolton <sup>77</sup> has completed a fascinating reconstruction of the "spirit of the East Midlands" as illustrated in the works of D.H. Lawrence. The image-altering power of such literary geography must surely be magnified by "media geography". Apparently, there have been no studies undertaken in the latter area, as yet.

Stea tried to chart the "invisible" or symbolic landscape that is formed by the interplay of these stereotypes with direct experience. <sup>78</sup> He suggested that it is the landscape that exists in men's minds that influences their decisions to move, or their feelings of being "at home" in a certain location. He contended that locations near mountains, the ocean, good ski slopes, or indeed any component of the environment, might be an attraction for an individual even though he might subsequently seldom see, or ever use, that particular feature. He felt that such subjective symbolic values could be positive or negative and could refer to specific or classes of objects. For example, he pointed out that two people might react in markedly different ways to the opportunity of spending a year near a large city. Such non-rational influences, he concluded, were "likely to be

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76. STRAUSS, A.L.  
The latest in urban imagery.  
In STRAUSS, A.L. (ed.)  
The American city.  
London. Allen Lane. The Penguin Press. 1968. Pp. 508-514.
77. SPOLTON, L. 1970.  
The spirit of place: D.H. Lawrence and the East Midlands.  
The East Midlands Geographer 5 (142), 38-96.
78. STEA, D. 1967.  
Reasons for our moving.  
Landscape 17 (1), 27-28.

of increasing importance in a world whose rewards, when they come, appear capricious, and whose most satisfactory outlet is often the mingling of fantasy with reality." 79

#### Image and personality

Sonnenfeld evaluated images and then interrelationships in another way. 80 Working with Arctic residents, and a control group in Delaware, he administered questionnaires to establish climatic environmental preferences, personal history, and personality. Key terms from the interviews (e.g. "storms", "northern lights", "seasons") were the bases of semantic differential profiles. Paired slides, rated "objectively" for relief, water, vegetation, and apparent temperature, were presented so as to force a choice on at least one aspect. Instructions were, "If you had to live for a year or two in one of these places which would you prefer?" He concluded that observed preference differences were not adequately explained by cultural, societal, or economic factors. Rather he suggested that past experience with a number of different environments may create a personality type "whose environmental preferences may be more akin to those of nonnatives from other regions, despite different environmental experiences, than to those native to his home region". The nonnative, as described by Sonnenfeld, tends to be attracted to what is exotic, adventurous, and new in an environment. When this aspect becomes tiresome, he will move unless his values and

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79. Ibid.

80. SONNENFELD, J. 1966.  
Variable values in space and landscape: an enquiry into the nature of environmental necessity.  
Journal of Social Issues 22 (4), 71-82.

and responsibilities have changed and with them his perception of environment. By analogy with physiological adjustments to a new environment Sonnenfeld suggested an autonomous, homeostatis-like psychological response to changed surroundings.<sup>81</sup> When a state of imbalance exists, and physical movement to the desired environment is not possible, choices of reading material, movies and television, and decorative photographs are suggested as possible compensatory channels to overcome deficiencies in the existing surroundings. Patterns of place preference form what Sonnenfeld termed, "environmental personality".

Campbell focuses on the long-term residents rather than on the movers to identify the "modal personality" of peoples in various settings.<sup>82</sup> By this he means the way a particular people regard the totality of their surroundings. His construct is based on a statistical abstraction of the personality of a number of residents, as measured by standardized psychological tests.

#### Image and belief

There are basic and enduring questions which influence the significance of environment in profound ways. How was the world created? What is the value and purpose of life? How does one learn truth? Is the future good? It is the answers, or even the inchoate ideas and beliefs, about these kinds of

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81. SONNENFELD, J. 1969.  
Personality and behaviour in environment.  
Proceedings, Assoc. of Am. Geog. 1, 136-140.

82. CAMPBELL, R.D. 1968.  
Personality as an element of regional geography.  
Annals, Assoc. Am. Geog. 58, 748-759.

questions that define a basic approach to life. To the extent that geographers have been concerned with these influences, their focus has been mainly on religious beliefs.

Fickeler studied the interactions among religious form, a people, and their landscape by looking at spatial variation in ceremonial practices.<sup>83</sup> Different sectors of the landscape were seen to take on connotations of "purity" and "impurity", and as such to attract or repel, for example: the peaceful garden; the oppressive desert. He concluded that "image cults", those religions with strong focus on physical shrines and elaborate ceremonial practices, were relatively strongest in areas of the Asiatic monsoon. In this class, he included the "higher nature religions of East Asia", Hinduism, southern and eastern Buddhism, and Lamaism. "Perceptual religions", such as Christianity were seen to flourish in the "dry steppe areas". Moderately ceremonial religions occupied the intermediate areas between these extremes.

Isaac attacked this descriptive approach as telling "us nothing of the reasons for the different operations of different religions or for the differing intensity of transformation of the cultural landscape by the same religion."<sup>84</sup> He contended that researchers must study the religion itself if they were to

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83. FICKELER, P. 1947.  
Fundamental questions in the geography of religions.  
In WAGNER, P.L. and MIKESELL, M.W. (ed.)  
Readings in cultural geography.  
Chicago. University of Chicago Press. 1962.

84. ISAAC, E.  
The act and the covenant.  
Landscape 11 (2), 12-17. Winter 1961-62.



understand its influence on environment. Isaac examined the minimal impact of the Shona people on the land in the Budja area, near Salisbury, Rhodesia. He contrasted this relatively small "stamp" on the environment with the elaborate symbolism impressed on the landscape by other religions where the group's concept of its origins involved world creation rather than the more limited creational link between sacrificial death and fertility celebrated in Budja ceremonies. Isaac contended that groups who sought to represent their beliefs of initial cosmic origin in worship rites would also, to some degree, try to reproduce these beliefs in their landscape. He offered as examples the Dogon of the Upper Volta Republic who "believed that twinness was a primordial principle" and thus built their villages in pairs called heaven and earth. Since they believed that the world was created in the shape of a spiral, the Dogon cleared their fields along a spiral axis. Districts, villages, and homesteads all repeated the primeval pattern.<sup>85</sup> As further examples, Isaac cited the Egyptian pyramids, which were symbolic of "the primeval hill which emerged from the waters of primeval chaos," and the ziggurats of Sumer which also replicated the cosmic mountain. In a similar vein, Tuan noted how the walled city of traditional China "was given a rectilinear pattern, of orientation, and a grandeur that reflected the order and dimension of heaven."<sup>86</sup>

In the context of attitudes to nature and land use, White argued that human action is deeply conditioned by beliefs about

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85. Ibid.

86. TUAN, Y. 1970.  
Our treatment of the environment in ideal and actuality.  
American Scientist May - June 1970, 244-249.



the meaning of life and the destiny of man, in short, by religion.<sup>87</sup> The Judeo-Christian tradition in the West, with its teleological emphasis, was seen to give faith in perpetual progress. With a god of history, a god of the "non-recurring event", time became a straight pathway leading upwards for a human race that had been set apart from, and given "dominion" over the rest of nature. In offering St. Francis of Assissi as the Patron Saint of ecologists, White predicted that the environment would continue to worsen until the "Christian axiom" that nature has no reason to exist save to serve man was overthrown.

Schaeffer takes a softer view than White of the Christian influence on the man/land relation, pointing out that under the Christian environmental ethic man has a responsibility to reverence all nature, himself included, because all nature is God's creation.<sup>88</sup> All things are to be revered according to their own natures - a stone less than a tree; an ant less than an elephant. Man's "dominion" extends over all creation for the purpose of maintaining human life but within limits of the rights of other parts of nature. Man does not have absolute rights such that for slight increases in his comfort he may despoil other parts of nature. As Glacken expressed the same idea "... Christian stewardship (is) closely linked with the responsibility that a temporal sojourner on the earth has toward posterity".<sup>89</sup>

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87. WHITE, L.  
*Machina ex Deo: Essays in the dynamism of Western culture.*  
 Cambridge, Mass. M.I.T. Press. 1968.
88. SCHAEFFER, F.A.  
*Pollution and the death of man: the Christian view of ecology.*  
 London. Hodder and Stoughton. 1970.
89. GLACKEN, C.J.  
*Traces on the Rhodian shore.*  
 Berkeley and Los Angeles. University of California Press.  
 1967. P.152.

Tuan denied that ideas of progressivism and "man over nature" were introduced by Christianity.<sup>90</sup> He noted that the "pre-Socratic philosopher Xenophanes believed in progress", and that technology had so progressed by the early Hellenistic period that Aristotle was led to boast, "Vanquished by nature, we become masters by technique". Tuan then rehearsed how China's forests were decimated despite widespread professions of belief in conservation. Fires were set for fun, or to destroy the habitat of harmful animals. Charcoal was needed for industry, soot for ink, timber for construction, and fuel for cremation. The latter use highlights the ironic contrast between "environmental words and environmental deeds" in that Buddhist monasteries were forest preserves, although their practice of cremation caused a timber shortage in the southeastern provinces, by the fourteenth century. It seems that Christian ideas cannot be blamed totally for man's persistent tendency to see himself as outside natural systems, an exploiter.

The importance of belief systems in organizing an environment into useable images is well illustrated when peoples migrate to markedly different settings or when groups with contrasting belief systems meet in the same area.

A classic example of the latter effect is given in Fonaroff's description of the generations-old conflict between Navajo herds-men and the American government.<sup>91</sup> Serious over-grazing had

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90. TUAN, Y. Op. cit.

91. FONAROFF, L.L. 1963.  
Conservation and stock reduction on the Navajo tribal range.  
Geographical Rev. 53 (2), 200-223.

prompted land reform attempts under the Dawes Act of 1897. Each Indian was set on his own piece of land in the hope that this "stake" in the future would convert him to "industry and Christianity". The semi-nomadic Navajo was used to "ownership by occupance" and saw no future beyond the cyclical repetition of the seasons. For him, quantity not quality of the stock was the measure of wealth, for "each has many more within". If the grass was thin it was because God was displeased and had withheld rain, but this could change for the better, as it had for the worse, without any activity on his part. Since "ghosts" were abroad at night all animals must be brought into the hogan, even though by morning the grass covering of the enclosure would be totally destroyed. Spirits also dictated that certain grazing areas be left unused.

If only their own welfare were at stake the Navajo may have been allowed to continue more or less unbothered, but unfortunately their overgrazing was accelerating the erosion process and causing rapid silting behind Boulder Dam. A crash programme was instituted to buy up Navajo sheep. Since the animals were in such poor condition it was economically advantageous to slaughter and bury them rather than transport to market. This "senseless" carnage confirmed to the Navajo that these people really were crazy . . . , and so the saga continued.

There are many examples of such clashes of belief about value. Brookfield found that the "inexplicably high values" placed on certain pieces of land by the Chimba in New Guinea became understandable when one knew of the bloody battles in which the

territory had been won.<sup>92</sup> Similarly, former owners of currently "undervalued" land were found to have died of some dread disease. Psychologist, William James<sup>93</sup> contrasted his impressions of "coves" cleared by North Carolina farmers with the views of residents. "... In short, the clearing, which to me was a mere ugly picture on the retina, was to them a symbol redolent with moral memories and sang a very paean of duty, struggle and success." Indeed, the utility and value of the various parts of environment depends on the users' beliefs of what is true.

Heathcote tells how unsuitable the attitudes of frugality and "waste not want not" of West European migrants were to their new Australia environment.<sup>94, 95</sup> This setting was better suited to an opportunistic strategy, which, in time, the people developed. In a similar way, Watson traces the influence of "illusion" in North American geography<sup>96</sup> and Warkenton describes the approach

92. BROOKFIELD, H.C.  
On the environment as perceived.  
In BOARD, C. et al. (eds.)  
Progress in Geography 1. 1959. Pp. 53-80.
93. JAMES, W.  
On a certain sense of blindness in human beings.  
Quoted in: LOWENTHAL, D. 1962.  
Not every prospect pleases.  
Landscape 12, 19-23. Winter 1962-63.
94. HEATHCOTE, R.L. 1963.  
Historical changes in the appraisal of pastoral land resources.  
Review of Marketing and Agricultural Economics 31 (4), 209-229.
95. HEATHCOTE, R.L.  
Back of Bourke.  
Melbourne. Melbourne University Press. 1965.
96. WATSON, J.W. 1969.  
The role of illusion in North American geography.  
Canadian Geographer 13 (1), 10-27.

to the environment that his Mennonite forebearers had evolved in their humid homeland in Southern Russia. In their new context of the semi-arid margins of South Manitoba their systems all but broke down, and underwent a prolonged period of adjustment to a new equilibrium level. <sup>97</sup>

The radically different cosmology of traditional China is described by Davisson, <sup>98</sup> Tuan <sup>99</sup> and Baltrusaitis. <sup>100</sup> Chinese reverence for the divine powers of nature is embodied in the concept of feng-shui. This is defined as "the art of adapting the residences of the living and dead so as to co-operate and harmonize with the local currents of the cosmic breath". <sup>101</sup> Feng-shui is a manifestation of the dragon myth in which the dragon is seen as "the essence of the male principle 'yang', the producer of rain, sun, heat, positiveness, light, fire, and goodness. Opposed to this is 'yin' which is feminine: moon, darkness, cold, negativeness, evil, and bad luck." The form of the dragon was sought in the landscape by the "Geomancer", who endeavoured to position and

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97. WARKENTON, J.  
Mennonites in Southern Manitoba.  
Lecture to the North American Studies Group.  
Edinburgh University. Autumn, 1970.
98. DAVISSON, R. Jr.  
The dragon and San Francisco.  
Landscape 17 (2), 12-15. Winter 1967-68.
99. TUAN, Y. Op. cit.
100. BALTRUSAITIS, J.  
Lands of illusion.  
Landscape 11 (2), 5-11. Winter 1961-62.
101. CHATLEY, H.  
Feng shui.  
In COULING, S. (ed.)  
Encyclopedia Sinica.  
Shanghai. P.175.  
Quoted from: TUAN, Y. Op. cit.

shape structures so that they would be in harmony with the yin and yang of the landscape. The points of the compass, light and shadow, running water, and movement of air all came into his calculations. Over the years the selections of the Geomancer were vindicated, as their occupants avoided poorly ventilated and flood-prone low ground to locate on the flanks of the dragon, yet below exposed ridges. Prosperity was seen to follow life in harmony with nature, and the utility of the cosmology was reinforced. Thus a set of images totally foreign to Western scientific thought were found to be of equal functional validity in organizing the physical environment.

#### Image and change

Popular images are constantly being up-dated to reflect current preoccupations and new knowledge. The point is well illustrated by Jackson's evolutionary history of American burial grounds, from the secret graves at weakened colonial outposts in Indian territory to the modern, almost cheerful, parklike cemeteries of California that cater for an increasingly transient population.<sup>102</sup> At each stage the symbolic values of the time are mirrored in the physical layout. The crisp, efficient rectangular grid plan so esteemed in the new territories also divided the burial plots. (c. 1800) Then, the family relationships held sway and the cemetery "was a place where wealth and family piety could assert themselves". During the nineteenth century concern with public health and distaste for the constant reminder of human impermanence produced the walled, secluded cemetery. Now, flush plaques

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102. JACKSON, J.B.  
From monument to place.  
Landscape 17 (2), 22-26. Winter 1967-68.

replace headstones in the interests of efficient maintenance, and only the sign proclaims to the passing eye that this is not just a well-kept public park. Francaviglia, too, finds that burial grounds are "miniturations and idealisations of larger American settlement patterns".<sup>103</sup> Neither of these authors comments on the apparent North American antipathy to cremation, although the negative image of this method must be an influence on the popular conception of burial grounds.

In this same context of abstracted reality Jackson examines changed attitudes to recreation in America.<sup>104</sup> He finds that the widely available opportunity of mobile individual sports, such as skiing, parachuting, surf riding, cycling, motor-cycling, and motor-boating have profoundly altered the leisure use of natural settings. Such individual means of locomotion allow a personal control during an adventuresome and sensual experience of what constitutes, in many ways, a new environment. Jackson interprets such sports as satisfying a need for excitement and danger that is increasingly absent from safe, modern life. Enjoyment derives from the sensations of egocentric travel itself, and from fleeting impressions snatched en passant. No longer is nature the subject of sedentary contemplation nor even necessary to the enjoyment of the new "abstract traveller".

Images of specific places are subject to the same editing process. Thompson describes such a reform in the image of

103. FRANCAVIGLIA, R.V. 1971.  
The cemetery as an evolving cultural landscape.  
Annals, Assoc. Am. Geog. 61, 501-509.

104. JACKSON, J.B. 1957. (b)  
The abstract world of the hot-rodder.  
Landscape 7 (2), 22-27.



California.<sup>105</sup> Up to about 1880 the high incidence of malaria in the Central Valley was blamed on "miasmas" rising from the swamps. When germ theory exploded the miasmatic myth, malaria control measures were instituted and a "new" and healthy California was created. Gould traces changes in the popular conception of Arctic lands from the early days of searches for a Northwest Passage and fur-bearing animals, through strategic military uses for trans-polar flights and Distant Early Warning Line defence operations, to the present day hopes for mineral bonanzas.<sup>106</sup> Today's outcry at the ecological consequences of removing the tundra's mineral wealth again illustrates how images change to reflect contemporary awareness and concern.

#### Conclusions on image studies

With the exception of reconstructions from historical and literary records, these studies are based on the, perhaps naive, belief that people can, and will, tell researchers what concepts are in their minds, and, further, that the "picture" which emerges bears some relation to the mental structure which that person would employ if required to act in that particular area of environment. In short, the research interview context is, usually, vastly different from the interaction context.

The utility of "mental map" and "place preference" studies is difficult to evaluate, because they depend, in most cases,

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105. THOMPSON, K. 1969.  
Insalubrious California: perceptions and reality.  
Annals, Assoc. Am. Geog. 59, 50-64.
106. GOULD, L.M.  
The polar regions in their relation to human affairs.  
New York. The American Geographical Society. 1952.



on recall by the subject in a research setting. In everyday life, as a person moves through his environment, his mental map will be constantly elaborated by recognition of cues not sufficiently well learned to be available to recall, yet available when cued. Moreover, functioning in a particular situation may depend on such personal variables as sense of direction, ability to read road signs, or general confidence in unfamiliar surroundings more than on any specific and recallable initial knowledge. Experimental approaches such as Sonnenfeld's paired landscape photos and game simulations go some way to overcoming these problems.

Concepts involved in mental map or preference studies may derive from either first hand or indirect experience. If the latter, the informational basis of evaluation has already been edited before the perceiver himself selects the parts important enough to be remembered. Direct perceptions are also subject to perceiver variations in the editing process. If, for example, one's impressions of London were formed on a single visit in a snowy winter afternoon while coming down with a cold, one would have little conceptual common ground on this subject with a healthy tourist who discovered the city in an abnormally dry and sunny period. Thus the interviewer investigating mental constructs may be interrogating subjects whose informational bases vary on a continuum from totally indirect to totally direct experience, and whose images also vary in character, recency, elaboration, and power. In short, there is a major sampling problem hidden in the collection, comparison and aggregation of images.

The main utility of image studies seems to be in aiding planners to provide physical units with which people are able to identify.

Of course, as the scale changes the sampling problem becomes more complex. But even at local scales useful work could be done using these techniques to compare, for instance, the neighbourhood feelings of residents inside and surrounding blocks of high rise flats.

#### OTHER APPROACHES IN BEHAVIOURAL GEOGRAPHY

A number of geographers have been concerned with stochastic modelling of decision-making in order to gain the capacity to predict distributions. Their studies include, among others, diffusion patterning and its computer simulation, and the applications of game theories. Although these projects involve perception, or at least assumptions about perceptual processes, their focus is on macro behaviour, without much emphasis on individual decision-making. Other geographers are seeking to explain distributions in "cognitive behavioural" terms. They prefer to place emphasis on the person's intellectual processes and build explanations upon individual functional significances. The following section is organized with studies emphasizing simulation technique first, followed by a sampling of the more cognitive behavioural approach.

#### Diffusion and simulation studies

Geographers have long been interested in the spread of ideas and practices from "hearth" areas. In general, the methodology of such studies involves an initial plotting of the distribution of the new practice over time. From this areal pattern an attempt is made to infer causal components. Social, economic and behavioural characteristics of the population, as well as the

character of the innovation itself, are considered as factors in "neighbourhood" or "contagion" effects. Jones<sup>107</sup> applies Rodger's<sup>108</sup> "S" and bell curves (Figure 3-4) to the observed spread of agricultural innovations in England and Wales. (Figure 3-5) Jones notes that the "climate of opinion" toward technical progress is a factor in adoption, as well as the degree of complexity of the innovation and its compatibility with existing practices.

Hagerstrand suggested that neighbourhood effects would operate around central places and that leap-frogging would occur to lower order central places which would then become diffusion centres for further contagion effects.<sup>109</sup> At some point, he contended, saturation would occur and diffusion would cease. Hagerstrand's "Monte Carlo" simulation technique<sup>110</sup> has been basic to a number of diffusion studies of which Johansen's investigation of strip cropping in Southwestern Wisconsin is typical. Johansen's objective was to simulate, on a gridded map, the adoption pattern

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107. JONES, G.E. 1963.  
The diffusion of agricultural innovations.  
J. Agricultural Economics 15 (3), 387-405.
108. ROGERS, E.M.  
Diffusion of innovations.  
New York. The Free Press. 1962.
109. HAGERSTRAND, T.  
The propagation of innovation waves.  
Land Studies in Geography No. B-4.  
Lund. Gleerup. 1952. P.8.
110. HAGERSTRAND, T.  
On Monte Carlo simulation of diffusion.  
In GARRISON, W.L. (ed.)  
Quantitative geography, part 1: economic and cultural topics.  
Studies in geography No. 13.  
Evanston, Illinois. Northwestern University Department of  
Geography. 1967. Pp. 1-32.

of strip cropping, from the following information:

- 1) "the number of potential adopters within each cell;
- 2) the locations of the adopters at the time of first observation;
- 3) locations of physical barriers (rivers, ridges, etc.)
- 4) probability that a randomly selected receiver falls within each psychological resistance category. These probabilities are chosen arbitrarily as an estimate of resistance; and
- 5) a mean information field which determines the probability that two individuals at a particular distance will communicate." 111

The basic model assumes that:

- 1) "only one person carries the item at the beginning;
- 2) the item is adopted at once when heard of;
- 3) information is spread only by telling at pairwise meetings;
- 4) telling takes place only at certain times with constant generation intervals, when each carrier tells one other person, carrier or non-carrier; and
- 5) the probability of being paired with a carrier depends on the geographical distance between teller and receiver in a way determined by empirical estimate." 112

Reduced probabilities of contact are built in for those cells isolated by geographical barriers or assessed "psychological resistance". The latter areas may require two, three, or four "contacts" before adopting, depending on the degree of resistance that the researcher calculates for that cell, based on available knowledge of its "social structure" and "communication channels". Johansen found that his simulation came close to reproducing the distribution of strip cropping from 1939 to 1967, as recorded on aerial photographs.

Gould suggests a game theoretical framework for analyzing the manner in which man "weighs the alternatives presented and the

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111. JOHANSEN, H.E. 1971.  
Diffusion of strip cropping in Southwestern Wisconsin.  
Annals, Assoc. Am. Geog. 61, 671-683.

112. Ibid.

rationality of his choices once they have been made".<sup>113</sup> In a simplified illustration, (Figure 3-6) the left vertical represents yields in "wet" years; the right, yields in "dry" years. The lowest point on the uppermost boundary indicates which crops the farmer should grow to maximize his yield. By taking the differences of wet and dry year yields for each of maize and hill rice and assigning these, "regardless of sign, to the alternative strategy, we can find the proportion each strategy should be used." In this example 77.4 percent maize and 22.6 percent hill rice. Gould also applies game theory evaluations to cattle traders' marketing strategies in Ghana. In a similar way, the "n-person game" is suggested by Wolpert and Ginsburg as a useful tool in simulating how different role groups do fit into modern "increasingly interdependent" decision-making processes.<sup>114</sup>

This brief sampling of diffusion and simulation studies suggests that they involve, at least, assumptions about the behavioural attributes of individuals, even though focusing on macro decision-making. For example, the operational definition of "resistance" in contagion effects presupposes some theory of individual functioning. Similarly, game simulations assume that the reward is valued by the "players". Thus a researcher using such techniques must have familiarity with the belief structures of the subjects, particularly when working in developing countries.

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113. GOULD, P.R. 1963.  
Man against environment: a game theoretic framework.  
Annals, Assoc. Am. Geog. 53, 290-297.
114. WOLPERT, J. and GINSBERG, R.  
The transition to interdependence in locational decisions.  
In COX, K.R. and GOLLEDGE, R.G. (eds.)  
Behavioural problems in geography: a symposium.  
Evanston, Illinois. Northwestern University.  
Studies in geography. No. 17. 1969. Pp. 69-80.

Cognitive behavioural approaches

Huff's decision theory<sup>115</sup> applies to consumer space preferences and is based on earlier work by Isard.<sup>116</sup> Huff hypothesizes that the elements in Figure 3-7 will relate, according to the arrow flows, to the five major interfaces. "Desideratum" is the desire aroused by the combination of physiological needs and the context in which such need feelings are experienced. "Value system", itself a compound of interacting factors, mediates among context, physical need and "behaviour-space perceptions". The latter refers back to the "stimulus situation" or context and involves all memories and inferences which may be brought to bear by the individual. "Movement imagery" embraces a similar set of expectancy evaluations for travel elements of the projected trips. On the basis of these four interfaces one shopping area is chosen and "overt behaviour" takes place. As the chosen activity is experienced its satisfactions are weighed against expectancies and stored information correspondingly adjusted for input to future decision processes. This descriptive scheme is intended to depict possible relationships among factors potentially involved in individual choice of shopping area. It does not indicate the relative strength of such factors, and is intended as a construct against which empirical research might be tested.

Rushton restates these ideas in his view of "spatial choice . . . as a comparison and evaluation of alternative spatial opportunities

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115. HUFF, D.L. 1960.  
A topographic model of consumer space preferences.  
Papers and Proceedings of the Regional Science Association  
6, 159-173.

116. ISARD, W.  
Location and space economy.  
New York. John Wiley and Son Inc. 1956.



against a personal preference function."<sup>117</sup> It had already been observed by Brennan<sup>118</sup> in Wolverhampton, and by Clark,<sup>119</sup> in rural Iowa, that consumers do not patronize the nearest centre offering the goods they wish to purchase. Rushton asserts that:

"... each decision-maker employs a mental search routine whereby alternative opportunities in space are compared and judged. ... Thus, the problem of constructing a model to predict spatial choice becomes one of finding this ranking of spatial opportunities and, in the long run, it becomes the problem of comparing one person's ranking against another's."<sup>120</sup>

From the theory of consumer behaviour in economics, he suggests an "indifference surface" in which each shopper would have his own demand curve for centres of varying population as a function of distance to be travelled. This concept, plus "attractiveness indices" were tested in Christchurch, New Zealand, but were found to offer little improvement on earlier methods.<sup>121</sup>

Eyles attacks the work of Clark and Rushton as being essentially a predictive extension of central place theory, with its attendant acceptance of the social forces producing variations in spatial distributions; "i.e. that the problems, manifested by differential access to resources and which are reflected in behavioural patterns, require no planned intervention".<sup>122</sup> In this concern that geographical theory be grounded in an "overall view of the structure

- 117. RUSHTON, G. 1969.  
Analysis of spatial behaviour by revealed space preference.  
Annals, Assoc. Am. Geog. 59, 391-400.
- 118. BRENNAN, T. Op. cit.
- 119. CLARK, W.A.V. 1968.  
Consumer travel patterns and the concept of range.  
Annals, Assoc. Am. Geog. 58, 386-396.
- 120. RUSHTON, G. Op. cit.
- 121. CLARK, W.A.V. and RUSHTON, G. 1970.  
Models of intra-urban consumer behaviour.  
Economic Geography 46, 486-497.

of society" with prescriptive objectives formed in the light of individual behaviour, Eyles appears to build upon a number of ideas expressed earlier in more general terms by Hagerstrand.<sup>123</sup>

Hagerstrand propounds what amounts to a sophisticated critical path description of human life, adaptable to many scales and situations (Figure 3-8). He focuses on constraints that limit access to resource use. "It is obvious that a low-income job, compared to a higher income job, gives access to fewer or inferior domains" (Figure 3-9). He sees many of these constraints as built into a rigidly structured system, or, in his words, "A society is not made up of a group of people which decides in common what to do a week ahead of time. It consists primarily of highly institutionalized power and activity systems." A majority of domains and temporary groupings within such systems:

"have a location in space, a duration over time, and a composition according to consciously or habitually pre-established programmes of organization which are made up with no particular regard to the individuals who happen to enter these systems and play the needed roles for portions of their life-paths".

Hagerstrand notes that restrictions imposed by societal structures inhibit expression of demand for such commodities as health care. He maintains that somewhere between biography and the study of aggregate behaviour there is a great need to investigate how individuality functions within such systems - how the structure of society looks from various points within and without its

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122. EYLES, J. 1971.  
Pouring new sentiments into old theories: how else can we look at behavioural patterns?  
Area 3 (4), 242-250.
123. HAGERSTRAND, T. 1970.  
What about people in regional science?  
Papers, Regional Science Association 24, 7-21.



component domains. "In the main, people are viewed as parts of activities to be performed within each domain in isolation, and not as entities who need to make sense out of their paths between and through domains". Failure to understand the frustrations inherent in such systems condemns us all to some extent to urban ugliness, overcrowded loneliness, and alienation from decision-making processes. He thus contends for research grounded in a broad concept of society and committed to betterment, to what ought to be.

Eyles' framework of spatial behaviour<sup>124</sup> thus appears to take its normative emphasis and the beginnings of "repressed preference" from Hagerstrand. The "framework" (Figure 3-10) shows "opportunity" as a function of social and spatial position and their attendant access to resources. "Image structure" depends also on social and spatial location. "Revealed preference" as indicated by "spatial behaviour" results from capitalized "opportunity". On the other hand, if "access to spatial resources" is denied, a "repressed preference" exists. Eyles points out that "repressed preference" is not involved in Rushton's "revealed space preference". He proceeds to elaborate the preference concept into "absolute", "manifest", and "latent" components. "Absolute preferences" refer to the very rich, who require the best available. "Manifest preferences" are those which are "usually pursued" even if not objectively the most advantageous. "Latent preferences" refer to desired actions which are not possible due to lack of "resources". Eyles suggests survey methods supplemented by "environmental games" and diaries as the most promising approach to uncovering latent

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124. EYLES, J. Op. cit.

preferences.

Wolpert addressed himself to the question of goals and means in his study of farming practices in middle Sweden.<sup>125</sup> He used a linear programming technique, similar to Gould's game theory, to evaluate the single most profitable combination of enterprises that was within the resource limitation of each of his eight study areas, in order to find "the potential productivity which the individual farmer could attain if his goal were optimization and his knowledge perfect". This optimum was compared with observed land use practices. The gap between ideal and actual was interpreted as deviation from the traditional theory of economic man, the omniscient profit maximizer. Wolpert sought reasons for observed areal variations from the calculated optimum in the characteristics of the people, concluding that the "concept of the spatial satisficer appears more descriptively accurate of the behavioural pattern of the sample population than the normative concept of economic man". Individual farmers are "intendedly rational" but consider only conspicuous alternatives (i.e. those with which they are familiar), and tend to be conservative in their attitudes to risk. The value systems and aspiration levels of the individual decision makers were found to be key variables in the distribution of farming practices.

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125. WOLPERT, J. 1964.  
The decision process in spatial context.  
Annals, Assoc. Am. Geog. 54, 537-558.

Pred's behavioural matrix <sup>126</sup> expresses some of these ideas graphically in a conceptual framework which focuses on the information available to decision-makers and on their capacity, for a variety of reasons, to use it. He too, attacks the unrealistic assumptions made about economic man, seeking rather to explain locational decision-making in terms of "bounded rationality". That is, a man can only take rational decisions within the limits of his knowledge and abilities. Pred's dynamic "behavioural matrix" in its barest form, shows knowledge varying from total ignorance to omniscience, and ability varying from ineptitude to total capability. (Figure 3-11) This framework is intended to allow ordinal comparisons of varying combinations of factors affecting information receipts and their use. The matrix has been criticised as "too cumbersome to operate" <sup>127</sup> and as a "vacuous device . . . a complete nonstarter as an analytical tool or as the conceptual basis for adequate theory". <sup>128</sup>

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126. PRED, A.  
Behaviour and location. Foundations for a geographic and dynamic location theory.  
Part 1. Land studies in geography. Series B.  
Human geography No. 27.  
C.W.K. Gleerup. Lund. 1967.
127. ADAMS, J.C.U. 1970.  
Review of "Behaviour and location" by Allan Pred.  
J. of Regional Science 10, 259-263.  
Quoted from: PRINCE, H.  
Real, imagined and abstract worlds of the past.  
In BOARD, C. et al. (eds.) Op. cit. Pp. 4-58.  
P.52.
128. HARVEY, D. 1968.  
Review of Pred (1967).  
Geog. Rev. 58, 313-314.  
Quoted from: JOHNSTON, R.J. 1972.  
Continually changing human geography: a review of some recent literature.  
New Zealand Geographer 28, 78-96. P.81.

In parallel with work by Lee,<sup>129</sup> Wolpert considers environmental decision-making in terms of a psychological stress-strain model:

" . . . A stress may be any influence, whether it arises from the internal environment or the external environment, which interferes with the satisfaction of basic needs or which disturbs or threatens to disturb the stable equilibrium."<sup>130</sup>

Mediating between such stress and resulting strain are "personality factors" which are defined as "cumulative physical, emotional and social experiences of the individual combined with his endowment". (Figure 3-12)

Wolpert contends that the purpose of locational decision-making is to alter the future in some way. " . . . Stayers may be said to reject the anticipated consequences of moving to another environment. Movers, on the other hand, wish to alter the anticipated consequences of not moving." Hsu uses a similar "homeostatic stress-strain" model to analyze historical records of locust infestations as an influence upon temple construction in traditional China.<sup>131</sup> He concludes that the psychological strain resulting from such infestations was reduced by increased worship as indicated by temple building.

Kirk restated and amplified his theory of behavioural and phenomenal environments in 1963.<sup>132</sup> He emphasized that man

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129. LEE, D.H.K. 1966.  
The role of attitudes in response to environmental stress.  
J. of Soc. Issues 22 (4), 83-91.
130. WOLPERT, J. 1966.  
Migration as an adjustment to environmental stress.  
J. of Soc. Issues 22, (4), 92-102.
131. HSU, S. 1969.  
The cultural ecology of the locust cult in traditional China.  
Annals, Assoc. Am. Geog. 59, 731-752.
132. KIRK, W. 1963.  
Problems of geography.  
Geography 48 (4), 357-371.

must be considered as part of, not separate from, the environment. In order to understand resource definition and decision-making in a particular spatial and temporal context the investigator must take on the values and situational constraints of that context. (Figure 3-13) According to Kirk's view a decision is taken on the basis of "social" and "physical" facts which are seen through the modifying filter of personal, sub-cultural, and cultural values, or by broadly human influences.

Sonnenfeld provides an extension to Kirk's "behavioural environment" concept.<sup>133</sup> He defines a nested set of environments (Figure 3-14) in which:

"The whole environment which is external to man, the entire world, is the objective 'geographical environment'. Within this larger sphere is included the 'operational environment' or the environment in which man operates. It consists of the portions of the world which impinge on man whether or not he is aware of it. The proportion of the operational environment of which man is aware is the 'perceptual environment'. The awareness may be derived either from learning and experience or from physical sensitivity to environmental stimuli. Thus, a portion of the environment at this level is symbolic, rather than objectively measureable. The least inclusive level is the 'behavioural environment', the portion which elicits a behavioural response or toward which behaviour is directed."

Kates summarizes the state of theory in national hazards research in terms of a general systems model of man in relationship to environmental threat.<sup>134</sup> (Figure 3-15) This scheme is particularly useful, because it focuses on the individual decision-maker, yet does not lose sight of aggregate behaviour. It incorporates observed adjustments, as well as the psychological

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133. SONNENFELD, J.  
Geography, perception and the behavioural environment.  
Paper presented at: Dallas AAAS, Dec. 27, 1968. Symposium  
on "The use of space by animals and man".  
Quoted from: SAARINEN, T.F. Op. cit.

134. KATES, R. 1970. Op. cit.



attributes of the individual. His model allows probability estimates to be attached to the various "black boxes", while at the same time permitting elaboration on the lines of cognitive behavioural theories.

#### CONCLUSION

"Image" literature is basic to this study insofar as the project involves questions of where and under what circumstances "air pollution" may be identified by a sample of Edinburgh residents. The project involves cognitive behavioural ideas in examining how the air pollution concept is elaborated, and in relating the concept structure to respondent attributes.

Of the approaches reviewed in this chapter, the present work relates most closely to natural hazards research. Kates' theoretical summary is particularly promising since it emphasizes human response to a risk situation, and has flexibility for aggregation of individual responses. As smog episodes are identified with increasing frequency and epidemiological studies illustrate the causal linkage between pollution exposure and illness, it becomes desirable to treat air pollution as an environmental risk situation. Natural hazards theory, and methods of adapting it for use with air pollution, are discussed in more detail in chapter seven. Past work on awareness and concern with air pollution is reviewed, briefly, in the following chapter.

## Chapter 4

### RESEARCH ON HUMAN RESPONSE TO AIR POLLUTION

#### INTRODUCTION

Formal studies of human response to air pollution are almost entirely a post-Second World War phenomenon, originating in the U.S.A. The post-war years were a time of rising living standards in North America, and it is perhaps natural that some of the higher expectations should find expression in a desire for environmental improvement.

The two immediate causes of increased concern were the Donora <sup>1</sup> and London <sup>2</sup> pollution episodes. (Table 4-1) In the U.S.A. these "disasters" apparently alerted government departments, principally Labour, and Health, Education and Welfare (HEW), to possible areas of neglected responsibility. <sup>3</sup> Research moneys were then made available, and the use of social survey techniques to assess human response to air pollution got under way.

The first part of this chapter assesses the overall development of this research:

- a) its purposes, methods, and principal conclusions;
- b) its spread to other countries.

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1. THOMPSON, D.J.  
Mortality, 1948 - 1957, and morbidity, 1957, among persons residing in Donora, Pennsylvania during the smog episode of October, 1948.  
Pittsburgh University. Graduate School of Public Health. 1957.
  2. LOGAN, W.P.D.  
The Lancet. 14 February, 1953.
  3. DE VILLIERS, A.J.  
Effects of air pollution on health.  
In WARD, M.A. (ed.)  
Man and his environment, Volume 1.  
Oxford. Pergamon Press. 1970. Pp. 159-176.



The second part compares findings, insofar as this is possible due to the heterogeneity of the studies.

## OVERVIEW

### United States

The first application of "attitude" or "perception" research to air pollution involved interviews with the local officials responsible for pollution control in New York State.<sup>4</sup> (Table 4-2) Social survey techniques were seen by the U.S. Department of Labour as a fast, relatively inexpensive way to gather information on the nature and severity of local problems, and to obtain first hand assessments of the functional adequacy of the existing legal framework. The study showed that about one half of the officials of urban communities in the State considered that their areas had a pollution problem, and over half of these areas had no smoke control laws. There was a general desire that government standards should be set so that controls would apply equally to all areas. This emphasis on standards and government initiative was to characterize the American approach to air pollution control in coming years.

The method used in New York State was adopted by HEW and a series of studies was carried out in co-operation with state

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4. STERN, A.C.  
Administrative needs and patterns of air pollution control.  
In MALLETT, F.S. (ed.)  
Problems and control of air pollution.  
N.Y. Reinhold. 1955. Pp. 32-41.



health departments over the next few years. 5 to 10 As a group, these had three principal aims:

- a) to find the location and perceived seriousness of air pollution problems;
- b) to collect information on local pollution laws and their operation;
- c) to assess perceived need for national or state legislation on air pollution.

These investigations tended to find that urban areas focused their concern on the processes involved in pollution, e.g. meteorological factors, and effects, whereas rural communities tended to fix upon a specific source as the sum total of air pollution in their area. The earlier studies mentioned soft coal in domestic heating as a problem source, but in the later investigations more emphasis was

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- 5. KENLINE, P.A.  
Appraisal of air pollution in Tennessee.  
Cincinnati, Ohio. Public Health Service (in cooperation with the State of Tennessee Dept. of Public Health). 1957.
- 6. PAGANINI, O., HIGH, M.D., KENLINE, P.A.  
Appraisal of air pollution in Texas.  
Austin, Texas. Texas State Dept. of Health. 1958.
- 7. BLAKENEY, B.C. and HIGH, M.D.  
Cleaner air for North Carolina.  
Raleigh, N.C. North Carolina State Board of Health, and Public Health Service. 1959.
- 8. ANDERSON, D.M., LIEBEN, J., and SUSSMAN, V.H.  
Pure air for Pennsylvania.  
Harrisburg. Pennsylvania Dept. of Health, and Public Health Service. 1961.
- 9. CARL, C.E. and CHRISTENSEN, G.L.  
Appraisal of air pollution in South Dakota.  
Prevere, S.D. South Dakota State Dept. of Health, and Public Health Service. 1962.
- 10. Results of questionnaire survey on community air quality standards.  
Preprint. Michigan University. 1962.

laid upon pollution from rubbish tips and the burning of oil and petrol. As these surveys were carried out, the proportion noting that their area had a "pollution problem" increased markedly with succeeding years.

This group of studies was used by HEW as a fact finding exercise in anticipation of state or national control legislation and the establishment of pollution monitoring networks. This type of investigation is seldom reported now, although two were carried out in the late sixties.<sup>11, 12</sup>

A second and parallel series of investigations, also under the aegis of HEW, involved sample surveys of the general population, following the archtype of Breslow's work in California.<sup>13</sup>

In 1956, the State of California Department of Public Health set out to measure these social and psychological dimensions of air pollution. Specifically they sought to locate residents who were annoyed by air pollution, and to evaluate the degree of their disturbance in terms of physical and mental health components, and intensity. Over the whole sample they hoped to find the extent of the state's air pollution problem as measured by people's awareness of it and by the effects on health and daily living

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11. NORTHEAST ILLINOIS PLANNING COMMISSION.  
Managing the air resource in Northeastern Illinois. 1967.
  12. GARTNER, I.  
Levels of program development of regional, state, and local air pollution control agencies.  
Preprint, Pennsylvania State University. Center for Air Environment Studies. 1968.
  13. BRESLOW, L.  
Air pollution effects reported by California residents.  
Berkeley, California. State of California Dept. of Public Health. 1956.

that people attributed to it.

Substantially the same methods were used on Staten Island<sup>14</sup> with an extension to include content analysis of newspaper clippings.<sup>15</sup> Other studies in this series were carried out at Buffalo, New York;<sup>16, 17, 18</sup> Clarkston, Washington and Lewiston,

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14. New York State Dept. of Health,  
Survey of public opinion on air pollution - Staten Island.  
In SAMUELS, S.  
The role of behavioural research in air pollution control.  
Background paper for:  
The symposium on the role of perceptions and attitudes  
in decision-making in resource management.  
University of Victoria. British Columbia. April 13, 1970.
15. BRIGHTMAN, I.J., RHIM, A., and SAMUELS, S. 1962.  
Air pollution and health.  
J.A.P.C.A. 12, 225-281.
16. Air pollution in Erie County.  
New York State Air Pollution Control Board. 1963.  
Reported: In Degroot, I. 1967.  
Trends in public attitudes toward air pollution.  
J.A.P.C.A. 17 (10), 679-681.  
and In BRIGHTMAN, I.J., RHIM, A., and SAMUELS, S.  
1962.  
Air pollution and health.  
J.A.P.C.A. 12, 225-281.
17. DEGROOT, I. and SAMUELS, S.  
People and air pollution: a study of attitudes in Buffalo,  
N.Y.  
New York State Air Pollution Control Board.  
Intradepartmental Report. No date.
18. DEGROOT, I., LORING, W., RHIM, A., SAMUELS, S.,  
WINKELSTEIN, W. 1966.  
People and air pollution: a study of attitudes in Buffalo,  
N.Y.  
J.A.P.C.A. 16 (5), 245-247.

Idaho; 19, 20, 21 Nashville, Tennessee; 22 St. Louis,  
Missouri; 23, 24, 25 and Birmingham, Alabama. 26, 27 Reviews  
of these projects are given by Degroot 28 and by Samuels. 29

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19. A study of air pollution in the Interstate Region of  
Lewiston, Idaho, and Clarkston, Washington.  
Cincinnati, Ohio. HEW.  
Public Health Service, Division of Air Pollution. 1964.
20. MEDALIA, N.Z. and FINKNER, A.L.  
Community perception of air quality: an opinion survey in  
Washington.  
Cincinnati, Ohio. Robert A. Taft Sanitary Engineering Center.  
1965.
21. NELSON, B.  
Air pollution: the "feds" move to abate Idaho pulp mill  
stench.  
Science, 157 (3792), 1018-1021. Sept. 1, 1967.
22. SMITH, W.S., SCHUENEMAN, J.J. and ZEIDBERG, L.D. 1964.  
Public reaction to air pollution in Nashville, Tennessee.  
J.A.P.C.A. 14 (10), 418-423.
23. SCHUSKY, J.  
Public awareness and concern with air pollution in the St.  
Louis Metropolitan Area.  
Edwardsville. Southern Illinois University. 1965.
24. SCHUSKY, J. 1966.  
Public awareness and concern with air pollution in the St.  
Louis Metropolitan Area.  
J.A.P.C.A. 16 (2), 72-76.
25. WILLIAMS, J.D. and BUNYARD, F.L.  
Interstate air pollution study - phase II project report -  
part VII.  
Opinion surveys and air quality statistical relationships.  
Cincinnati, Ohio. HEW. 1966.
26. ROBISON, C.B., CHAMBERS, J.C. and BATES, J.W.  
Defining the problem of air pollution in Metropolitan  
Birmingham, Alabama.  
Jefferson. County Dept. of Health. 1967.
27. STALKER, W.W. and ROBISON, C.B. 1967.  
A method for using air pollution measurements and public  
opinion to establish ambient air quality standards.  
J.A.P.C.A. 17 (3), 142-144.
28. DEGROOT, I. 1967.  
Trends in public attitudes towards air pollution.  
J.A.P.C.A. 17 (10), 679-681.
29. SAMUELS, S.  
Assessment of perceptions of air pollution.  
In SEWELL, W.R.D. and BURTON, I. (eds.)  
Perceptions, attitudes and resource management.  
Ottawa. Queen's Printer. 1972.

Summaries of purposes and methodology are provided by Schusky and her co-workers,<sup>30</sup> and by Medalia.<sup>31</sup>

Following the development of the "HEW school", university researchers became increasingly interested in the human implications of air pollution. A team of sociologists, headed by Van Arsdol, evaluated the congruence of "perception" with "reality" over a range of environmental hazards, including air pollution, in the Los Angeles area.<sup>32</sup> In Pasadena, a group from the California Institute of Technology focused their interviews on the "bother" occasioned by air pollution, and on the respondents' willingness to pay in taxation or increased prices for improved air quality.<sup>33</sup>

Gold surveyed attitudes in the State of California with special attention to the degree of concern expressed about air pollution in different geographical areas of the state and by different social groupings.<sup>34</sup> Also in California, Johnson and his

30. SCHUSKY, J., GOLDNER, L., MANN, S.Z., LORING, W.C. 1964. Methodology for the study of public attitudes concerning air pollution. J.A.P.C.A. 14 (11), 445-448.
31. MEDALIA, N.Z. 1964. Air pollution as a socio-environmental health problem: a survey report. J. of Health and Human Behaviour 5 (4), 154-165.
32. VAN ARSDOL, M.D., SABACH, G., and ALEXANDER, F. 1964. Reality and the perception of environmental hazards. J. of Health and Human Behaviour 5 (4), 144-153.
33. SILVERBLATT, H., WEISS, M., SMITH, N., SMITH, J., McENNERNEY, S., GREEN, D., CEDERBAUM, E. A survey of the Pasadena community air pollution. In Air pollution project: an educational experiment in self-directed research. Pasadena. Associated Students of the California Institute of Technology. 1968. Pp. 75-131.
34. GOLD, D. Public concern and beliefs about air pollution in California: a statewide survey. In Project Clean Air. Santa Barbara. California University Dept. of Sociology. 1970.

associates sought to find, "how people were affected by smog and their gut reactions to it." <sup>35</sup> This project also involved assessment of subjective problem hierarchies and the perceived locus of responsibility for air pollution control.

While working in Morgantown, West Virginia, Lawyer found a difference in attitude toward air pollution between those who felt present air quality was an improvement on that of former years, and those who did not. <sup>36</sup> Here, too, a "picture stimulus approach" was used to ascertain how much smoke could be seen to come out of a chimney before respondents would find it objectionable. <sup>37</sup> Also in West Virginia, Rankin investigated public attitudes to air pollution in the Kanawha Valley ( Charleston, Nitio, and Montgomery). General optimism and willingness to pay for pollution controls was noted, but there was a strong reluctance to admit the presence of air pollution in the home area. <sup>38</sup> Rankin interpreted this in terms of "personal invulnerability feelings, more usually associated with high risk undertakings."

"What people say air pollution means to them" was Crowe's

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35. JOHNSON, D.L.  
Air pollution - public attitudes and public action.  
American Behavioural Scientist 533-561. P.534.
36. LAWYER, R.E. 1966.  
An air pollution public opinion survey for the city of Morgantown, West Virginia.  
West Virginia University, Morgantown.
37. RIVERS, M.E. and LINSKY, B.  
A picture stimulus approach to visible air pollution plume investigation.  
Preprint. A.P.C.A. Pittsburgh, Pa. 1971.
38. RANKIN, R.E.  
Air pollution control and public apathy.  
J.A.P.C.A. 19, 565-569.

point of departure for a "definitional model" of perception. <sup>39</sup>  
 Educational level, socio-economic status and residence location  
 were most marked in explaining the observed variation in definitional  
 content.

The meaning of air pollution in Toronto was investigated by  
 Barnes <sup>40</sup> and Shepherd, <sup>41</sup> and reported by Auliciems and Burton. <sup>42</sup>  
 This report is particularly valuable because it includes an  
 evaluation of human capacity for sensing various pollutants, and  
 concludes that people are capable of accurate monitoring of only  
 the relatively innocuous, coarse particulate matter, and are poorly  
 suited to detecting more noxious pollutants unless they are present  
 in extreme concentrations.

Two final "university" studies are work by Saarinen and Cooke  
 in Tucson, Arizona, <sup>43, 44</sup> and Mason's project at Eugene and

39. CROWE, M.J. 1968.  
Toward a "definitional model" of public perceptions of air  
pollution.  
J.A.P.C.A. 18 (3), 154-157. P.154.
40. BARNES, P.A.  
Community awareness and concern with air quality in Toronto:  
a pilot study.  
Unpublished B.A. thesis, University of Toronto. 1968.
41. SHEPHERD, B. 1970.  
Mentioned: In AULICIEMS, A. and BURTON, I.  
Perception and awareness of air pollution in  
Toronto.  
Toronto. National hazard research. Working  
paper No. 13, 1970.
42. AULICIEMS, A. and BURTON, I. 1970.  
Perception and awareness of air pollution in Toronto.  
Toronto. National hazard research. Working paper No. 13.  
1970.
43. SAARINEN, T.F. and COOKE, R.U.  
Public perception of environmental quality in Tucson,  
Arizona.  
Occasional papers. Dept. of Geography.  
University College, London. Oct. 1970.



Salem, Oregon.<sup>45</sup> The former follows the methodology of the HEW studies but the latter is original in its attempt to investigate the effects of pollution levels during the interview period on interview responses. Visibility estimates were taken as indicators of pollution. These were not found to be systematically related to response pattern.

On the national scale in the U.S.A. professional opinion samplers have carried out studies of popular attitudes toward pollution problems. The first of these, by Opinion Research Corporation, concluded that air pollution was a matter of concern only where a severe problem existed, and that industries were held to be the prime villains.<sup>46</sup> They also found only limited awareness of the economic implications of pollution control.

The National Wildlife Federation commissioned a nationwide study by the Gallup Organization in 1969.<sup>47</sup> This survey showed air pollution to be the "most pressing problem connected

44. SAARINEN, T.F. and COOKE, R.U. 1972.  
Public perception of environmental quality in Tucson, Arizona.  
J. Arizona Academy of Sciences 6, 260-274.
45. MASON, R.G.  
Social aspects of changes in air quality.  
In Annual report: Corvallis Air Resources Center, 1970 - 71.  
Corvallis. Oregon State University. 1971.
46. Opinion Research Corporation.  
National poll on pollution problems 1965.  
In SETTLE, A.E. 1966.  
Public opinion and community involvement.  
J.A.P.C.A. 16 (9), 490-491.
47. The U.S. public considers its environment.  
Princeton, N.J. The Gallup Organization Inc.  
Conducted for the National Wildlife Federation.  
February, 1969.

with our natural surroundings".<sup>48</sup> Control of car exhaust was seen as the most needed area of action by about one-quarter of the sample.

Copley International conducted a survey of the national odour problem in the U.S. in 1970.<sup>49</sup> Although they found that many citizens were aware of odours and objected to their presence, few were sufficiently concerned to make a complaint to a government agency. The Copley technique of using a vapour dilution device to present known concentrations of odours to a representative panel is a well established method,<sup>50</sup> frequently used to investigate the nuisance of diesel exhaust.<sup>51</sup> Although no mechanical substitute has yet replaced the human nose in the assessment of smell, subjective estimates of dust concentrations have been less successful.<sup>52</sup>

48. CAHN, R. 1969.  
Poll finds alarm over pollution.  
The Christian Science Monitor. March 11. P.5.
49. Copley International Corporation.  
National survey of the odour problem. Phase 1 of a study  
of the social and economic impact of odours.  
Contract E.P.A. 22-69-50. 1970.
50. For example:  
HORSTMAN, S.W., WROMBLE, R.F., and HELLER, A.N. 1965.  
Identification of community odour problems by use of an  
observer corps.  
J.A.P.C.A. 15 (6), 261-264.
51. For example:  
SPRINGER, K.J. and HARE, C.T.  
A field survey to determine public opinion of diesel engine  
exhaust odour.  
San Antonio, Texas. Southwest Research Institute. N.A.P.C.A.  
1970.
52. DRASCHE, H. 1971.  
How precise is the subjective evaluation of dust concentration?  
REINHALTUNG LUFT 31 (12), 490-492.

### Scandinavia

Scandinavian research of this type has tended to focus on the social impact of a single source on its surrounding area. Friberg and Strandberg located an increased incidence of bronchitic symptoms near an oil shale plant which emitted sulphur dioxide, hydrogen sulphide, and dust in considerable quantity.<sup>53</sup> In a similar study around a sulphate cellulose plant, Friberg and his associates found an inverse relationship between "disturbance" reported by respondents and the distance of their homes from the factory.<sup>54</sup>

Around a similar plant, Cederlof reports that in a follow-up investigation of a petition regarding air pollution, almost half of the petitioners declared that they had not experienced "annoyance" because of the flue gases.<sup>55</sup> Petitions are thus rejected by the author as a useful index of nuisance. He also found that respondents with heart, or respiratory conditions, or sensitivity to other environmental factors, such as noise, were more likely to be bothered by pollution from the sulphate-cellulose factory.

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53. FRIBERG, L. and STRANDBERG, L.  
Studies of sanitary nuisance and health hazards from flue gases - an interview survey.  
In Proceedings: Conference on Public Health Aspects of Air Pollution.  
Milan. 1957.  
Copenhagen. World Health Organization. Pp. 56-69.
  54. FRIBERG, L., JONSSON, E. and CEDERLOF, R. 1960.  
Studies on sanitary nuisance of smoke from a sulphate cellulose factory. (1) An interview study.  
Nord. Hyg. Tidskr. 41, 41-62.
  55. CEDERLOF, R., FRIBERG, L., JONSSON, E., KAIJ, L. and LINDVALL, T. 1964.  
Studies of annoyance connected with offensive smell from a sulphate cellulose factory.  
Nord. Hyg. Tidskr. 45, 39-48.

Jonsson followed this line of investigation with six studies of sociological factors relating to annoyance reactions in the presence of air pollution and noise. <sup>56</sup> He concludes that only sex and, for women, age were related to experienced bother.

Lindvall used similar information on bother to compare with isopleths of odour concentrations predicted on the basis of source concentration and meteorological factors. <sup>57</sup> His model adequately predicted downwind concentrations on the basis of levels of "bother".

#### United Kingdom

Much of the work on the perception of air pollution in the U.K. has focused on the operation of smoke control areas under the Clean Air Act, 1956. The executive of the National Society for Clean Air sent questionnaires to 1703 local authorities in March of 1960. <sup>58</sup> Returns from England and Wales were sixty-six percent, but only forty percent of Scottish local authorities complied. On the whole, responses showed a "favourable" attitude toward smoke control areas.

Edinburgh Corporation carried out a sample survey, principally in the Sighthill smoke control area, during the spring and early

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- 56. JONSSON, E. 1964.  
Annoyance reactions to external environmental factors in different sociological groups.  
*Acta Sociologica* 7, 229-263.
  - 57. LINDVALL, T. 1969.  
The nuisance effects of air pollutants.  
*Nord Hyg. Tidskr.* 50, 99-115.
  - 58. MARSH A., TURNER, W.C. and BIRTWISLE, E.M.  
Inquiry into the working of the Clean Air Act - reports on the questionnaire.  
*In Proceedings of the Harrogate Conference - 1960.*  
London. N.S.C.A. Pp. 140-167. P.140.

summer of 1961.<sup>59</sup> The conclusion was that "not one of the 600 persons questioned could think of a single disadvantage of living in a smoke control area." The same high degree of resident satisfaction with smoke control areas was found a decade later by Holtby in her study in Manchester.<sup>60</sup>

Interviews carried out by the Association of Public Health Inspectors indicated that when changes of fuel were made, as an area came under smoke control, the trend was to prefer gas and electricity to solid smokeless fuel.<sup>61</sup>

Since 1970, a number of researchers have been investigating public response to air pollution on a broader scale. Among the first of these was McBoyle, who concluded that the apathy toward air pollution which he observed in his hometown of Aberdeen was the result of four factors: old age; low income; long association with coal fires and their attendant smoke; and a belief in personal invulnerability from pollution effects.<sup>62</sup> Other studies by

59. Annual report of the Chief Sanitary Inspector. 1964. Edinburgh. Edinburgh Corporation.

60. HOLBY, F.E.  
Air pollution in Manchester.  
Aberystwyth. University College of Wales.  
Unpublished B.Sc. 1971.

61. Association of Public Health Inspectors annual conference. Eastbourne. Sept. 1963.  
Reported in: Clean air yearbook - 1964 - 65.  
London. N.S.C.A.

62. McBOYLE, G.R.  
The public perception of air pollution in Aberdeen.  
Paper: Man and Environment Commission symposium.  
Calgary. July 24-30, 1972.

Chapman<sup>63</sup> in the West Riding of Yorkshire, Blacksell in Exeter,<sup>64</sup> and Wall in Sheffield<sup>65</sup> are to be published in completed form during 1973.

#### Japan

On the basis of available English summaries, it would appear that Japanese work has followed American models. Complaints to authorities regarding specific sources have, in many cases, led to interview investigations on a concentric ring, or pie segment sampling strategy.<sup>66 to 70</sup> Sample surveys of cities or administra-

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63. CHAPMAN, V.  
The public perception of air pollution as an environmental problem in the East Riding of Yorkshire.  
Paper: Man and Environment Commission symposium.  
Calgary. July 24-30, 1972.
  64. BLACKSELL, M.  
Attitudes toward smoke control in Exeter.  
Paper: Man and Environment Commission symposium.  
Calgary. July 24-30, 1972.
  65. WALL, G.  
Public response to air pollution in Sheffield, England.  
Paper: Man and Environment Commission symposium.  
Calgary. July 24-30, 1972.
  66. NISHIYAMA, K., NAGAYASU, M., AZYMA, T. and ISHIZAWA, M. 1968.  
Studies of the prevention of public nuisance by the exhaust gases from the kraft pulp mill. Part 3. Influences of odour on N-area inhabitants.  
Shokoku Acta Medica 24, 43-52.
  67. SHIGETA, Y., HOSHIKA, Y., ISHIGURO, T., and TSUCHIHASHI, S. 1969.  
The research of bad odour on the fish meal plants.  
J. Japan Soc. Air Pollution. 4 (1), 86.
  68. MIYOSHI, H., FUKUDA, A., MIZUKI, T. 1970.  
Epidemiological case study on complaints of odour.  
J. Japan Soc. Air Pollution 5 (1), 143.
  69. HOSHOKA, Y., NIKI, S., ISHIGURO, T., KATORI, Y., SHIGETA, Y.  
Importance of opinion survey using questionnaires in odour pollution survey. Report No. 3 on studies of odour. Presented at the Disaster Prevention Chemistry Meeting, Japan, January 11, 1971.  
Paper 20.

tive districts have also been undertaken, 71 to 75 using questionnaires broadly similar to those employed in the HEW studies. The perception of smells has received relatively more attention in Japan than in the U.S.A., possibly because Japanese researchers were undertaking this work in the late 1960's, a time of rising concern with odour problems in America.

### Conclusion

There are many obstacles to the comparison of findings among the studies. (Table 4-2) Differences in the timing of interviews, both seasonally and over the years, probably affect the results due to changes in air pollution concentrations or changed attitudes toward the environment in general. Such changes could

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70. Toyama Prefecture.  
Report on health surveys of Fukuoka-Cho citizens.  
Toyama. 1971.
71. WATANABE, S. and WAKABA, K. 1969.  
Public attitudes toward air pollution in Muroran.  
J. Japan Soc. Air Pollution 4 (1), 68.
72. KAIGISHO, T.S.  
Public nuisance - present status and countermeasures in the industrial areas of Joto and Jonan. Tokyo.  
Tokyo Chamber of Commerce and Industry. 1970.
73. Nagoya Municipal Office.  
Report on the effect of air pollution on children of Nagoya City.  
Nagoya. 1970.
74. Yokohama Isogo Ku medical association.  
Community opinion survey on regional environment in Isogo Ward, Yokohama City.  
Yokohama. 1969.
75. HARASHIMA, S., MIYASAKA, T., SUZUKI, T., HISINUMA, J.  
A report concerning the community opinion survey on environmental pollution, 1967.  
Tokyo. Tokyo University Faculty of Medicine,  
Department of Industrial Health. 1968.



result from mass media providing new knowledge about a pollution problem, thereby arousing dissatisfaction with the existing situation, or from improved economic circumstances which could make long-desired improvements seem more possible. The relative position of cities with respect to the local balance of those factors would be expected to change from year to year and thus to complicate further any direct comparison of interview findings.

Methods of measuring and recording air pollution levels are not standardized, and different effects may be produced by objectively equal emission concentrations due to variations in latitude, climate, and the unique mixture of pollutants in each city. This mix may also be composed significantly of unmonitored components.

Study scales, purposes, and methods of sample and population selection vary widely, thus putting comparisons on an unequal basis. Unequal sample sizes raise questions of reliability.<sup>76</sup> Differing purposes and questionnaire designs present further comparison problems. Some seek spontaneous answers, others use forced choice or semi-projective techniques. Phrasing<sup>77</sup> and sequencing<sup>78</sup> of

76. MOSER, C.A.  
Survey methods in social investigation.  
London. Heinemann Educational Books Ltd. 1958.
77. For example:  
DURBIN, M. and MICKLIN, M. 1969.  
Syntactic dimensions of attitude scaling techniques: source of variation and bias.  
Sociometry 32, 194-206.
78. For example:  
GALLUP, G. 1947.  
The quintamensional plan of question design.  
Public Opinion Quarterly 11 (3), 385-393.

questions are also sources of variation. <sup>79</sup>

The administration of face-to-face interviews varies with the experience, dedication, interest, and supervision of personnel, <sup>80</sup> and with the rules and training given. Such factors will not be constant from study to study. Mailed questionnaires receive varying response rates, and it is questionable whether these returns are representative of the sample population. Conclusions based on groupings of responses or indices introduce arbitrary elements and further frustrate comparisons, while statistics based on single questions are most liable to context, wording and interviewer effects.

For these reasons, detailed comparison of response frequencies to seemingly comparable interview questions are of doubtful validity. However, where general conclusions agree across studies, despite heterogeneous methods, there may be greater basis for confidence in the broad factors that have been found to influence the perception of air pollution. It is to this second level that the following section is directed.

#### TRENDS IN RESEARCH FINDINGS

In this section some of the major questions that have occupied researchers on human response to air pollution are used to organize research findings, and thus to locate areas of concensus, controversy, and inconclusion.

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79. For example:  
HAGBURG, E.C. 1968.  
Validity of questionnaire data: reported and observed attendance in an adult education program.  
Public Opinion Quarterly 32, 453-456.
80. For example:  
Williams, J.A. 1968.  
Interviewer role performance: a further note on bias in the information interview.  
Public Opinion Quarterly 32, 287-294.

Perception versus reality measures

A major emphasis in a number of studies has been the comparison of human and non-human perceptions of air pollution. A wide variety of criterion aerometric data and questionnaires have been involved. (Table 4-2) As well as being of academic interest, this comparison was thought, in the early studies at least, to have practical potential, in that if people could be shown to be reliable monitors of pollutants, opinion studies might be used in place of expensive air monitoring programmes. Although few would hold to this view now, it still has relevance for odour problems.

Degroot and Samuels used a combination of smoke, sulphation and dustfall data to give a "score of air pollution" for each sector of Buffalo. This index of "actual" neighbourhood air pollution was evaluated as an influence on interview responses, with the conclusion that it was the "over-riding variable" explaining response variation.<sup>81</sup>

Such composite "scores of air pollution" are at least somewhat arbitrary, and are specific to place, time and monitoring equipment used.

On Staten Island a long history of complaints about bad air had been observed to originate in known high pollution areas. This fact, plus agitation by the Island's Action for Clean Air Committee, encouraged the New York State Department of Health to undertake an investigation. Questionnaires soliciting opinions about air pollution were mailed to residents of four census

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81. DEGROOT, I. and SAMUELS, S. Op. cit.

tracts. (Table 4-2) Two were on the "clean" side of the Island and two on the "dirty" side. Both sets were inland to limit visual stimulus from mainland sources. Concern, as expressed by returned and completed questionnaires, was only slightly greater in the "dirty" areas than in the "clean" (thirty-one and twenty-four percent, respectively).<sup>82</sup>

Smith and his associates at Nashville had an extensive air sampling network (Table 4-2) from which to develop an air pollution standard.<sup>83</sup> Parts of the city were assigned to low, medium, and high pollution categories. They found, in general, a rather weak, positive connection between pollution levels and concern for air pollution as a health risk. "Bother" was "closely related to pollution levels". The relationship was even stronger for those who specified "bother" as resulting from "property damage" rather than from "respiratory" complaints. Within socio-economic strata, "bother" increased with air pollution level. In "low" and "medium" air pollution areas more lower socio-economic class women were "bothered", but in "high" air pollution areas high socio-economic class women were "bothered" more. (Figure 4-1)

The best aerometric indicator of concern, both in winter and annually, was the "2+ days" index. (Table 4-2) It was assumed, therefore, that opinion is more influenced by unusually high incidents than by average conditions. The authors' additional assumption that odour-causing pollutants would be released along with contaminants included in the "index" and would thus not

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82. SAMUELS, S. Op. cit.

83. SMITH, W.S., SCHUENEMAN, J.J., and ZEIDBERG, L.D. Op. cit.

materially affect the pattern of concern is questionable.

When "air pollution", "socio-economic" and "concern" indices were calculated for each area of the city, "concern" and "air pollution" were seen to decrease radically, while "socio-economic" increased toward the perimeter. (Figure 4-2) Although the sample was large (2835) statistical significance did not extend to relationships among population variables.

A converse situation was found by Williams and Bunyard in St. Louis. There, high volume particulate data had most "cause and effect relationship" to opinions of respondents.<sup>84</sup> Volumetric SO<sub>2</sub> data was least related and both geometric mean and 99th percentile levels gave the same results, based on 1000 feet, square grid cells. They postulated that if people were in fact more concerned with the variability of air quality than with average levels, opinion data would show an increase as the ratio of 99th percentile to geometric mean increased. Since this was not found, they concluded that people were concerned with general conditions and not mainly with extremes. This is exactly opposite to Smith's conclusion at Nashville.

"High" and "Low" odour frequency ratings were assigned on the basis of survey data from St. Louis Division of Air Pollution Control. These gave unexpected results in that people in areas of low odour perceived odour problems more often. This result was explained as being due to socio-economic, educational, and local problem priority factors. The more obvious explanation, that an odour is more noticeable against a customarily odourless

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84. WILLIAMS, J.D. and BUNYARD, F.L. Op. cit.

background, seems to have been discounted. Once again there are the difficulties of more or less arbitrary data divisions and indices discussed above. As well, the precision of the criterion data cannot be evaluated, particularly on odour, because it was supplied by another agency and its method of derivation was not published.

In Birmingham, Alabama, Stalker and Robison noted significant correlations between annual and winter season geometric means of dustfall and public attitude to air pollution "as a general nuisance" (correlations 0.80 and 0.82 respectively).<sup>85</sup> When all six pollutant measures (Table 4-2) were set as independent variables in a multi-regression analysis, dustfall explained forty-nine percent of total variation in spring and sixty-eight percent in winter. On this basis an air quality standard of thirty tons per mile squared per month was proposed as potentially satisfying to two-thirds of the population. A tacit conclusion is that no control limits can be based on opinion data for  $\text{SO}_2$ , sulphate,  $\text{NO}_2$ , or aldehydes because measured levels did not correlate with public awareness. Implicit, too, is the assumption that perception of air pollution is relatively constant through time. Winter air pollution is correlated with spring perception measures. There is no consideration given to the possibility that the prevailing air quality during the time of interviewing may significantly affect the opinions expressed.

In 1956, separate rankings of the census tracts of Los Angeles County were made for smog incidence, and for concern about

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85. STALKER, W.W. and ROBISON, C.B. Op. cit.

smog as expressed in interviews with residents.<sup>86</sup> The result was a "close correspondence" between the two rankings.

Van Arsdol and others in Los Angeles considered floods, bush fires, noise, air pollution, and earth slides in relation to "perceived and actual" measures of the threat of each.<sup>87</sup> For smog, thirty-nine percent of the respondents perceived its presence in "hazard" neighbourhoods while sixteen percent perceived it when the threat was absent, according to objective measures. The authors emphasized that because of sample size, arbitrary selection of variables, and imprecise criterion measures, findings were tentative.

Auliciems and Burton approach the reality/perception relationship by examining human physiological capabilities in recognition of air pollutants.<sup>88</sup> They conclude that the sensory basis of perception is limited to olfactory, visual and tactile experience of "fairly harmless pollutants". As an illustration of the influence of anticipated effects on perceptions of air pollution, they note that almost one third of the 1967 sample in Toronto mentioned eye irritation as a personally experienced effect in spite of the absence of climatic conditions required to produce eye-stinging photo-chemical smogs. There was, however, no shortage of reports about such effects occurring in Los Angeles. They conclude that popular response to air pollution is strongly influenced by information received through the communications media.

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86. BRESLOW, L. Op. cit.

87. VAN ARSDOL, M.D., SABAGH, G. and ALEXANDER, F. Op. cit.

88. AULICIEMS, A. and BURTON, I. Op. cit.



Medalia finds no difference in perception from "polluted" to "non polluted" neighbourhoods,<sup>89</sup> and concludes that "personality, social status, and cultural" factors, in the presence of air pollution, explain the distribution of concern. This study, however, is on a markedly smaller city and sample size than the others. (Table 4-2)

In the markedly different context of Eastern Europe, responses from Probald's sample conformed well to the levels of pollution observed by researchers.<sup>90</sup> In the other Eastern European study, Kromm noted that the types of pollution sources named by the respondents were present in the area, in roughly the proportions mentioned.<sup>91</sup>

In the U.K., McBoyle's respondents did not distinguish between week-day pollution and the generally lower week-end levels.<sup>92</sup> Wall's sample showed agreement of awareness with known pollution distribution, but, over the years, changes in complaints frequencies did not mirror changes in air quality.<sup>93</sup>

Rankin<sup>94</sup> and Kromm<sup>95</sup> confirm the conclusion of Schusky<sup>96</sup>

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- 89. MEDALIA, N.Z. Op. cit.
  - 90. PROBALD, F.  
A comparative field study of the air pollution problem in Budapest.  
Paper: Man and Environment Commission symposium.  
Calgary. July 24 - 30, 1972.
  - 91. KROMM, D.E. and VIZJAK, S.  
Response to air pollution in Ljubljana, Yugoslavia.  
Paper: Man and Environment Commission symposium.  
Calgary. July 24 - 30, 1972.
  - 92. McBOYLE, G.R. Op. cit.
  - 93. WALL, G. Op. cit.
  - 94. RANKIN, R.E. Op. cit.
  - 95. KROMM, D.E. and VIZJAK, S. Op. cit.
  - 96. SCHUSKY, J. 1965. Op. cit.

and Degroot <sup>97</sup> that pollution problems are considered to be less serious in the home area than in the city as a whole. McBoyle <sup>98</sup> suggests that no matter what frame of reference is suggested in the question, people tend to answer in terms of neighbourhood experience. Yet, his respondents "almost never" included their home area among "those areas most affected by air pollution". Wall <sup>99</sup> and Johnston and Hay, <sup>100</sup> note no such "neighbourhood halo effect" in their responses.

Perceived seasonality of pollution levels has been suggested as another dimension of reality/perception comparisons. Breslow's California sample agreed that summer was the worst season for air pollution, <sup>101</sup> as did Toronto respondents, <sup>102</sup> and Schusky's St. Louis group. <sup>103</sup> This apparent concensus among North American findings has been interpreted by Schusky, and reasserted by Auliciems and Burton, as evidence that awareness of air pollution is more a function of seasonality in human activity patterns than of seasonality in pollution levels. Although this explanation may be satisfactory for Toronto and St. Louis, in the California context, findings suggest a congruence of popular opinion with

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- 97. DEGROOT, I. and SAMUELS, S. Op. cit.
  - 98. McBOYLE, G.R. Op. cit.
  - 99. WALL, G. Op. cit.
  - 100. JOHNSTON, R.J. and HAY, J.E.  
Spatial variations in awareness of air pollution distributions.  
Paper: Man and Environment Commission symposium.  
Calgary. July 24 - 30, 1972.
  - 101. BRESLOW, L. Op. cit.
  - 102. AULICIEMS, A. and BURTON, I. Op. cit.
  - 103. SCHUSKY, J. 1965. Op. cit.

pollution monitoring records. A similar accord is noted by McBoyle for Aberdeen<sup>82</sup> where the objectively "dirty" winter season was chosen by respondents with twice the frequency of any other season. It could be argued that because the eye-stinging smog of California and the acrid coal smoke of Aberdeen are extremely noticeable, residents in these places are more aware of the seasonality of pollution. In neither of these locations, however, are climatic variations as extreme as to restrict outdoor activity, as is the case in the northern parts of North America in winter. In such areas as St. Louis and Toronto the winter outdoor experience of most residents would be confined to a dash from building to car, with an occasional quarter hour spent shovelling snow. In short, variation in seasonal activity patterns seems to be a possible explanation of these findings. None of the studies attempt to relate interview information to climatological indices such as the frequency and duration of anticyclonic weather.

What conclusions may be drawn regarding perception/reality congruence for air pollution? It appears there is a general relationship between dirty air and high awareness and concern. Usually, this relationship rests on particulate matter, both suspended and dustfall, because, of the pollutants considered, these produce effects most observable by human senses. A similar relationship for perceived smell will possibly be established when more objective "reality" measures of odour are possible. Concern based on health threat, material damage, or psychological stress requires a learned connection which cannot be naively perceived in a first-hand experience. Some people in the population could

be expected to have learned these connections, but more will be aware of only those effects which can be simply and directly linked to "things in the air".

There is general evidence for a "neighbourhood halo effect", in which respondents are unwilling to attribute problems to their home area. This has been explained in terms of feelings of "personal invulnerability", and of neighbourhood loyalty. It seems equally likely that this may be an indicator of a mental defence mechanism whereby problems that can be denied a personal dimension are suppressed, thus minimizing the imperative to act.

To some extent, other factors seem to be involved. Recent marked changes in air quality, for example, after establishment of a polluting industry or a smoke control zone, could be expected, by contrast, to change attitudes. Similarly, increased personal exposure, even to lesser pollution levels of summer, could produce increased awareness. Media reports of air quality trends, research findings, or industrial accidents involving pollution threat, all help on the one hand to create cause and effect linkages which aid perception and make possible changes in the morality applicable to the use of environment. On the other, pressing personal or community problems, such as unemployment, war or natural disaster, may occupy attentions of reporters and "power leaders", and inhibit further development and present operation of individual perceptual mechanisms for postponable problems such as air quality.

Thus many investigators shift the emphasis from opinion/reality congruence to the development of hypotheses incorporating factors potentially affecting the perception mechanism. In such

attempts socio-economic variables have figured prominently.

#### Socio-economic variables

##### "Class"

Socio-economic level, or class, was defined in a wide variety of ways. In some cases there was no explicit definition; in others, the index involved education, income, and occupation, either singly or in some combination.

Smith and his colleagues reported that high "socio-economic status" was associated with extreme concern about pollution in the central area of Nashville, but not in the relatively unpolluted suburbs.<sup>104</sup> (Figure 4-1) A similar finding in Clarkston was explained by Medalia<sup>105, 106</sup> in terms of the higher social class members' ability to distinguish "personal" from "community" problems. Although occupational social class was, in the latter study, related to concern, it was not associated with variation in "awareness" or personal "bother".

Johnson's Los Angeles sample showed air pollution to be a middle and upper class concern, with minority groups, apparently all of whom were "lower class", more concerned about "racial injustice, poverty, (and) police harassment . . ." <sup>107</sup> Saarinen and Cooke also reported evidence for upper class concern about air pollution.<sup>108</sup> The same group was found by Crowe to define air pollution in terms of causation rather than "specifics" favoured by lower class

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104. SMITH, W.S., SCHUENEMAN, J.J. and ZEIDBERG, L.D. Op. cit.

105. MEDALIA, N.Z. Op. cit.

106. MEDALIA, N.Z. and FINKNER, A.L. Op. cit.

107. JOHNSON, D.L. Op. cit. P.537.

108. SAARINEN, T.F. and COOKE, R.U. Op. cit.

respondents.<sup>109</sup> Van Arsdol<sup>110</sup> and Degroot<sup>111</sup> could find no linkage between social status and pollution perception.

### Education

Persons who had completed senior years in secondary school were, in most studies, included in the "high" educational grouping. This group, and the lowest education respondents, of the three categories used in the St. Louis sample, were found to be unlikely to consider making a complaint about air pollution.<sup>112</sup> Schusky explained that the latter group might not know where to complain, or might be afraid, while the former might have less need to complain, because most of them lived in the relatively cleaner suburbs. However, the high education sector was more likely to note health effects of pollution, and to feel that air pollution was a problem requiring regulation at state or bi-state level.

Although Degroot found no relationship between educational level and the rated "seriousness" of air pollution, he did note that the frequency with which respondents remembered reading something about air pollution in newspapers increased with educational level.<sup>113</sup> Similarly Crowe found that the complexity of definitions was greater for respondents with more schooling.<sup>114</sup>

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109. CROWE, M.J. Op. cit.

110. VAN ARSDOL, M.D., SABAGH, G. and ALEXANDER, F. Op. cit.

111. DEGROOT, I. and SAMUELS, S. Op. cit.

112. SCHUSKY, J. 1965. Op. cit.

113. DEGROOT, I. and SAMUELS, S. Op. cit.

114. CROWE, M.J. Op. cit.

This group were also more likely to express concern about pollution problems. <sup>115, 116</sup>

Creer reported that the lower educational segment of his sample placed greater stress on the need for increased controls on pollution. <sup>117</sup> When Kromm asked his sample whether they would walk rather than add to pollution by using their cars during an air pollution episode, he found that, "The distance that respondents stated they would walk was directly proportional to education - the greater the years of schooling, the less kilometers indicated." <sup>118</sup>

Although education has been shown in these studies to be related to certain specific answers, it has not been observed to be strongly associated with a wide range of responses, nor has the direction of the observed relationship been consistent from study to study.

#### Sex

There is disagreement regarding the relationship of the respondents' sex to expressed views about air pollution. Degroot reports that the women in his sample were more aware of "dust in their neighbourhoods" than men. <sup>119</sup> Smith explains a similar result in terms of women being "in more intimate contact with

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115. GOLD, D. Op. cit.

116. The U.S. public considers its environment. Op. cit.

117. CREER, R.N., GRAY, R.M. and TRESHOW, M. 1970. Differential response to air pollution as an environmental health problem. J.A.F.C.A. 20 (12), 814-818.

118. KROMM, D.E. and VIZJAK, S. Op. cit.

119. DEGROOT, I. and SAMUELS, S. Op. cit.



most of the matters involved." <sup>120</sup> Yet, Crowe <sup>121</sup> and Schusky <sup>122</sup> find that both sexes use the same terms in discussing air pollution.

In the national survey reported by Cahn, <sup>123</sup> more males were "deeply concerned" about air pollution than females (fifty-six and forty-six percent, respectively). Chapman <sup>124</sup> too, found males more concerned, with a higher proportion ranking air pollution near the top of their problem hierarchies.

The studies of Friberg <sup>125</sup> and Medalia <sup>126</sup> both concern attitudes of residents near a single, smelly source. Yet, their findings on the influence of the respondent's sex conflict. Friberg notes that women were more disturbed than men; Medalia that, if anything, men were more aware of the pollution than women.

In Kromm's study, statistically significant response differences were found in potential adjustments to a pollution episode. <sup>127</sup> For example, women were more likely to consider stopping smoking, but were less likely to think of leaving the polluted area.

There are, apparently, certain types of questions, notably

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- 120. SMITH, W.S., SCHUENEMAN, J.J. and ZEIDBURG, L.D. Op. cit.
  - 121. CROWE, M.J. Op. cit.
  - 122. SCHUSKY, J. 1965. Op. cit.
  - 123. CAHN, R. Op. cit.
  - 124. CHAPMAN, V. Op. cit.
  - 125. FRIBERG, L., JONSSON, E., and CEDERLOF, R. Op. cit.
  - 126. MEDALIA, N.Z. Op. cit.
  - 127. KROMM, D.E. and VIZJAK, S. Op. cit.

those dealing with possible adjustments and with household matters, that elicit different responses from men than from women. Yet, contradictory findings, and the weakness of the reported relationships, suggest that sex is not a major influence on response patterns.

#### Age

In most studies increasing age was found to be a negative influence on awareness of air pollution. For Kromm's sample in Ljbljana,<sup>128</sup> the young were more willing to consider adjustments involving moving from a high pollution area, either temporarily or permanently, but they were less likely to think of seeing a doctor or giving up the use of cars, in connection with air pollution. In contrast, older respondents were more likely to react by closing windows and staying indoors. For Kromm's sample, the thirty-six to forty-five age group, with high school or equivalent education, were significantly more likely to be aware of air pollution in the area (0.05 level). In a similar way, Saarinen and Cooke<sup>129</sup> found that concern about air pollution increased with age to about forty, and thereafter decreased. In McBoyle's<sup>130</sup> sample old age was associated with denial of an air pollution problem. Friberg<sup>131</sup> and Creer<sup>132</sup> noted that younger

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128. Ibid.

129. SAARINEN, T.F. and COOKE, R.U. Op. cit.

130. McBOYLE, G.R. Op. cit.

131. FRIBERG, L., JONSSON, E., and CEDERLOF, R. Op. cit.

132. CREER, R.N., GRAY, R.M. and TRESHOW, M. Op. cit.

respondents tended to be more bothered by air pollution than the older group.

Blacksell<sup>133</sup> reported the reverse of these trends in Exeter. There, twenty-three of the twenty-six who recognized an air pollution problem in the area were over forty, and four were over sixty-five. Van Arsdol,<sup>134</sup> Degroot and Samuels,<sup>135</sup> and Medalia<sup>136</sup> found no relationship between responses and age.

Overall, where age was found to be related to responses, the relationship was in the direction of increasing age inhibiting awareness and concern.

#### Length of residence

This variable has been used in past studies to test two basic hypotheses:

- a) Awareness and concern about pollution will increase with the years of exposure;
- b) Perception of pollution will become increasingly blunted as one becomes accustomed to the local situation.

Medalia and Finkner's work tends to support the first hypothesis, that of "exacerbation".<sup>137</sup> They note a greater concern about pollution among long-term residents, particularly those of high occupational social class. Degroot also presents a statistically significant distribution (0.05 level) to show that the longer the

133. BLACKSELL, M. Op. cit.

134. VAN ARSDOL, M.D., SABAGH, G. and ALEXANDER, F. Op. cit.

135. DEGROOT, I. and SAMUELS, S. Op. cit.

136. MEDALIA, N.Z. and FINKNER, A.L. Op. cit.

137. Ibid.

period of residence, "the more often 'serious' responses occurred." 138

On the other hand, McBoyle finds evidence for the second hypothesis, "habituation". He concludes, "... there seems to be a crucial point in time after which continued exposure to the phenomenon accustoms an inhabitant to its existence..." 139

In a similar vein, Kromm notes that long-shared experience with a hazard tends to produce a homogeneous attitude toward it within the population, and to minimize individual variations in adjustments to it. 140

On the basis of these studies no conclusion can be drawn about the relative strength of habituation and exacerbation effects on response to air pollution.

#### Home ownership

Only Degroot reported on this variable. 141 He found no difference in awareness or perceived seriousness between owners and renters. There was, however, a significant tendency for owners to agree that air pollution had an effect on real estate prices.

#### Family structure

Both Van Arsdol and Degroot attempted to relate family structure to attitudes about air pollution. The former reported that "... persons who had never married were concerned less

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138. DEGROOT, I. and SAMUELS, S. Op. cit.

139. McBOYLE, G.R. Op. cit.

140. KROMM, D.E. and VIZJAK, S. Op. cit.

141. DEGROOT, I. and SAMUELS, S. Op. cit.

frequently with air pollution than were people who had been or were presently married." <sup>142</sup> Concern was found to increase in direct proportion to monitored pollution levels for families of three to five members, but not larger families. This is interpreted as evidence of "a clear-cut concern for the welfare of young children". <sup>143</sup> Van Arsdol found no relationship between perception of air pollution as a hazard and family composition. <sup>144</sup>

Although Degroot's evidence is inconclusive and is weakened by the lack of confirmation from Van Arsdol, the possible influence of family structure remains an hypothesis worth further testing.

#### Smoking habits

Among the women in Degroot's sample, smokers showed a significant tendency to rate air pollution as a more serious problem than did the non-smokers. <sup>145</sup> This is interpreted as a transference of blame for a recognized health threat from the personal habit to the general problem. When smokers were considered as a group, male and female, these effects disappeared. In his 1962 survey, Degroot noted that males who smoked cigarettes only were more likely to express negative feelings about air pollution than persons who used other smoking methods. Although these findings carried statistical significance they were based on subgroups having as few as eleven members. Blacksell could find no evidence that smokers

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142. Ibid. P.11.

143. Ibid.

144. VAN ARSDOL, M.D., SABAGH, G., and ALEXANDER, F. Op. cit.

145. DEGROOT, I. and SAMUELS, S. Op. cit.

in any way related their habit to a general concept "air pollution". 146

Thus, there is little evidence to confirm the intuitively appealing hypothesis that smokers should adopt a characteristic attitude toward air pollution.

### Conclusions

Overall, socio-economic and demographic variables present a somewhat inconsistent pattern. There is evidence that the young and middle age groups are more aware and concerned about air pollution than are the elderly. Findings regarding the influence of the respondent's sex on interview responses are contradictory. There is better agreement that verbal facility, and a greater breadth of knowledge, characterize the views of the highly educated group, as would be expected on any subject. Expressions of "concern", however, are not consistently related to educational level. Nor is the influence of socio-economic status unanimously agreed.

On balance, there seems to be evidence for air pollution as an upper and middle class concern, with lower classes preoccupied by more pressing problems. Regarding length of residence, there is almost a balance of findings on the relative influences of exacerbation and habituation effects. This variable seems of dubious utility insofar as it becomes entangled with age, and requires a rather mobile population to have significant numbers in the "new citizen" category, unless, of course, the sample is very large.

There was little evidence that home ownership or smoking habits were influences on responses to air pollution.

Although there was some suggestion that the parents of families of moderate size would be more concerned about pollution, this was found only in one study,<sup>147</sup> and was not confirmed.<sup>148</sup>

#### Neighbourhood satisfaction

In a number of studies, the air pollution interest of the interview was kept hidden at the outset to provide an opportunity for spontaneous mention of air quality as a positive or negative factor in the respondent's subjective evaluation of his home area. This "neighbourhood satisfaction" variable could then be cross-tabulated with more specific responses dealing with air pollution obtained later in the interview.

Schusky reported three and a half percent of her sample as mentioning air quality as a desirable aspect of their areas.<sup>147</sup> This proportion tended to be higher in the suburbs, and lower in the city centre. As a spontaneously mentioned local dislike, air pollution ranked eighth. Sheffield results showed a similar tendency for the frequency of complaints about air pollution to decrease with monitored pollution levels, and for pollution to be relatively low in problem hierarchies.<sup>148</sup> In Exeter, three and a half percent mentioned air pollution as a disadvantage of their area.<sup>149</sup> Fully one-third of the Clarkston sample noted this local problem, yet most of these also indicated general satisfaction with their neighbourhood, and did not find air pollution to be a cause of "personal bother".<sup>150</sup>

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147. SCHUSKY, J. 1965. Op. cit.

148. WALL, G. Op. cit.

149. BLACKSELL, M. Op. cit.

150. MEDALIA, N.Z. and FINKNER, A.L. Op. cit.



Van Arsdol observed a similar relationship between satisfaction and awareness of air pollution in the Los Angeles area.<sup>151</sup> Although air pollution was the most frequently mentioned cause of discontent in Saarinen's Tucson sample (thirteen percent), there was no consistent relationship between expressed neighbourhood contentment and the problem hierarchy ranking of pollution.<sup>152</sup>

On the basis of these studies, there is some evidence to suggest that those highly satisfied with their neighbourhoods will be more concerned about air pollution. There is a stronger consensus that air pollution comes rather far down the "spontaneous problem hierarchy", and that the frequency of complaints about air quality generally conform closely to actual pollution levels in the residence area.

#### Information sources

Attempts to elicit information sources were generally of the type, "Do you recall hearing anything about air pollution (on radio) recently?" Responses to this and to similar questions for other potential information sources were then cross-tabulated with other interview answers. In Degroot's sample, those having no information sources about the subject were less likely than others to rate it as a "serious" problem, or to be concerned about possible health effects.<sup>153</sup> Those who did remember reading a newspaper story about air pollution were, in turn, less likely to give a "serious" rating or to express concern

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151. VAN ARSDOL, M.D., SABAGH, G. and ALEXANDER, F. Op. cit.

152. SAARINEN, T.F. and COOKE, R.U. Op. cit.

153. DEGROOT, I. and SAMUELS, S. Op. cit.

about health effects than those getting information from radio or television. By far the most remembered items were from newspapers (about eighty percent of the 1962 sample).

Schusky distinguished between "personal communications", such as discussions with a friend or doctor, and information from mass media.<sup>154</sup> She found the former to be strongly related to ratings of air pollution as a serious problem, and to a desire to complain about it. Neither of these relationships existed with the mass media information receipt group.

Medalia observed that respondents expressing high concern about air pollution were more likely than others to claim to know the local newspaper's views on the subject, and to claim to have read an article about air pollution recently.<sup>155</sup> This may be further evidence that people choose reading material in accordance with existing interests, or it may simply indicate that people like to keep their responses consistent throughout the interview.

These investigations suggest two, as yet unconfirmed, hypotheses about the relative power of different information sources about air pollution:

- a) the more personal is the source, the more powerful is its effect;
- b) radio and television generate stronger concern than do newspapers.

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154. SCHUSKY, J. 1965. Op. cit.

155. MEDALIA, N.Z. and FINKNER, A.L. Op. cit.

Cognitive dissonance

Many researchers have observed that human beings cannot tolerate prolonged inconsistency between their actions and their beliefs.<sup>156</sup> Creer hypothesized that economic dependence upon a polluting industry would influence one's perception of the seriousness of that pollution and of the extent of control efforts.<sup>157</sup> His experiment was carried out in a Utah community of 7000 where a large steel plant, employing forty percent of the population, constituted the only major source of air pollution. The hypothesis appeared to be confirmed in that eighty percent of the "low economic dependence" group were "highly bothered", compared with only nineteen percent of the "high economic dependence" group.

Watanabe and Wakaba, however, in their investigations at Muroran, Hokkaido, found that responses did not "differentiate" between people "related" to the polluting industry and those who were not.<sup>158</sup> Against this, Ohira reports that respondents who work in the principal polluting industry in his sample area at Mizushima tend to ignore "nuisances".<sup>159</sup>

Gregory's study of Haverton Hill<sup>160</sup> residents could be interpreted as supporting Creer's hypothesis. Those not wishing to

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156. For example:

BREHM, J.W. and COHEN, A.R.  
Explorations in cognitive dissonance.  
London. John Wiley and Sons. Inc. 1962;  
FELDMAN, S. (ed.)  
Cognitive consistency.  
London. Academic Press. 1966.

157. CREER, R.N., GRAY, R.M., and TRESHOW, M. Op. cit.

158. WATANABE, S. and WAKABA, K. Op. cit.

159. OHIRA, M., MARUYA, H., and NAGIRA, T. 1969.  
A study of awareness and opinion of the residents about  
public nuisances in Mizushima.  
Japan J. Hyg. 24 (1), 99.

160. GREGORY, P.  
Polluted homes.  
London. G. Bell and Sons Ltd. 1965. P.58.

move from the highly polluted area were more likely to be employees of the polluter; however, distance to work and rental charges on company houses could be complicating factors.

The cognitive dissonance hypothesis seems most applicable to the worker in a well-known "dirty" job, for example, the cleaning room of an iron foundry. For others in such an industry the existence of these jobs may make their own work seem clean and safe by comparison, thus reducing the personal risk impetus to cognitive distortion. In short, workers in a polluting industry are not equally exposed to risk from that pollution.

The other basic assumption of the cognitive dissonance hypothesis, that of a need to have positive feelings about the social responsibility of one's employer, seems equally suspect. In general, hourly workers have few positive feelings of any kind toward management, and indeed are more likely to give allegiance to, and feel personal involvement with, their union. Thus it seems unlikely that they would subjectively distort their surroundings to aggrandize the employer.

The lack of consensus in the above research reports reflects the fundamental weakness of the hypothesis, as it has been expressed.

#### Recognition of air pollution

Data on awareness were often derived from questions such as, "Would you say there is air pollution in this area?" In St. Louis, a greater proportion were bothered by air pollution than recognized it as present in their neighbourhood. (Table 4-3) This is interpreted by Williams and Bunyard as an indication that some "bother" occurred away from the home area.<sup>161</sup> Equally,

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161. WILLIAMS, J.D. and BUNYARD, F.L. Op. cit.

this may be a further example of the "neighbourhood halo effect" noted above.

Definitions of air pollution given by those "aware" of its presence in their neighbourhoods were found by Crowe to be more "specific".<sup>162</sup> This is difficult to interpret because the poorer "lower classes" tend to live in objectively more polluted areas where they might well encounter the "grit" and "smuts" elements of the "specific" definition. Also, it is known that lower class respondents tend to give more laconic, often single word answers, e.g. "smoke", "dirt", "dust"; whereas the upper class member may produce a well organized response of a number of sentences.

The summary of responses indicating awareness of air pollution in the home area (Table 4-3) is more than a little misleading. Not only are sample sizes, methods and interview purposes markedly different (Table 4-2), but also the city sizes involved range from approximately 7000 for Clarkston and "Utah Town", to just over 50,000 for Charleston, and almost one million for St. Louis. For the smaller cities specific sources would be more notable, while response in larger cities would be more to the general situation. Survey times could also be important insofar as concern about environment was increasing rapidly in the second half of the sixties when Creer<sup>163</sup> and Rankin<sup>164</sup> did their work.

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162. CROWE, M.J. Op. cit.

163. CREER, R.N., GRAY, R.M. and TRESHOW, M. Op. cit.

164. RANKIN, R.E. Op. cit.

### Air pollution as a problem

Comparison of the problem ratings and rankings presented in Table 4-4 is difficult. The populations involved varied from national, to city, to rural farm; the problems against which air pollution was to be judged were different, as was the actual nature of each area's pollution situation; studies in areas of acknowledged low pollution, Chapman in East Yorkshire and Blacksell in Exeter, showed low problem ratings. In general, high ratings began first in Los Angeles, with increasing priority accorded in other cities during the late sixties and early seventies.

One index of problem priority was "bother". Responses were elicited with such questions as, "Are you bothered by air pollution?" . . . "In what ways?" Answers were then tabulated under such headings as psychological stress, annoyance, and physical complaints.

#### Bother

Although "depression" was the main pollution effect reported in Johnson's Los Angeles survey,<sup>165</sup> eye irritation was the principal source of bother for three-quarters of Breslow's all-California sample.<sup>166</sup> About fifteen percent of the latter had given "serious consideration" to moving because of air pollution. Four percent had moved in the past, for this reason. In-migrants were much more likely to be bothered than were the general population. Among the former group, those coming because of "climatic advantage" were most annoyed with air pollution.<sup>167</sup>

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165. JOHNSON, D.L. Op. cit.

166. BRESLOW, L. Op. cit.

167. Ibid. P.28.

Those affected by air pollution were more likely to be dissatisfied with their community. The latter finding, however, was not confirmed by Medalia,<sup>168</sup> Schusky,<sup>169</sup> or Smith.<sup>170</sup>

In St. Louis, respondents were asked whether they had ever "wished to complain" about air pollution.<sup>171</sup> It was concluded that, since only one-quarter of those who wished to complain actually had, the frequencies on complaints records should be multiplied by four to indicate the true dimension of "bother". The same ratio occurred in both Buffalo samples,<sup>172</sup> and approximately the same in Charleston.<sup>173</sup> A desire to complain was related to a "very serious" rating for air pollution as a problem, and to lack of confidence in local officials, in St. Louis. However, the potential complainers often did not know where to direct their comments. Those receiving their information about pollution through personal contacts, e.g. friends, work mates, were more likely to wish to complain and to carry it out, than were those receiving their information via media.

Samuels investigated the reasons people gave for not complaining.<sup>174</sup> He found that about forty percent felt that others had already complained so their action would be redundant; one-quarter said the government would not do anything anyway. On

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168. MEDALIA, N.Z. Op. cit.

169. SCHUSKY, J. 1965. Op. cit.

170. SMITH, W.S., SCHUENEMAN, J.J. and ZEIDBERG, L.D. Op. cit.

171. SCHUSKY, J. 1965. Op. cit. Eighteen had wished to complain.

172. DEGROOT, I. and SAMUELS, S. Op. cit.

173. RANKIN, R.E. Op. cit.

174. SAMUELS, S. Op. cit.



this basis he rejected the frequency and intensity of actual complaints as an index of existing annoyance, a conclusion shared by most other researchers involved with this question.

#### Health effects

A list of eighteen possible symptoms was presented to Breslow's California sample. The proportion who had experienced items from the list was higher in the Los Angeles area than in less polluted parts of the state. Asthma complaints were the health effect most frequently linked with air pollution. Among bronchitics almost one-fifth felt worse during air pollution episodes. Although almost half of the Los Angeles County respondents reported "feeling tired and low" as a chronic symptom, only a tenth of these attributed this to air pollution.<sup>175</sup>

Some other responses linking health to air pollution are summarized in Table 4-5. In general, spontaneous mention of air pollution as a threat to health, without prior mention of the intent of the interview, is rare. Nashville shows less than five percent in the "unprompted" category. When the purpose of the interview has been revealed and the question is "forced choice" rather than open ended, percentages attributing health effects to air pollution soar into the eighties and nineties. The relatively low proportion in Lewiston/Clarkston who "worry" about the effects of air pollution on their personal health suggests a reluctance to apply a generally acknowledged health threat to oneself.

Those in Medalia's sample who did acknowledge a danger to

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175. BRESLOW, L. Op. cit. Pp. 55-56.

personal health were significantly more likely than others to express high concern about air pollution. Both Buffalo samples found a similar tendency for more "serious" ratings by those who felt some health risk, an effect particularly marked, in both Buffalo and St. Louis, for those who actually had respiratory impairments. Awareness of health risk was also related, in Schusky's sample, to desire for more government action on pollution control, and in Nashville to a tendency to be "bothered".

Health effects are, apparently, not the first thing communicated when one is asked about air pollution. Both Crowe and McBoyle found relatively small proportions constructing definitions in terms of health effects. Yet, there seems to be a pervasive willingness to agree that air pollution harms health, when the idea is presented to the respondent. Crowe interprets this in terms of psychological "masking", whereby obvious and innocuous elements of the problem are offered in order to avoid consideration of its more threatening dimensions.

The apparent inconsistency between admitted general health threat and denied personal risk is also explained in psychological terms. McBoyle suggests this is an example of personal invulnerability of the kind which reportedly allowed people to live through bombing raids in the last war, with apparent unconcern, secure in the belief that no harm could come to them.

On the basis of these studies, it appears that beliefs about the possible effects to personal health from air pollution are a crucial influence on a whole range of interview responses.

### Other effects

A straight-forward comparison of the effects summarized in Table 4-6 is not possible. Some items were open ended, as in Nashville, Exeter, Sheffield and Aberdeen; others forced a choice among two or more alternatives. The phrasing of these questions causes problems too. The Buffalo query is both leading and general, whereas its counterpart in Lewiston/Clarkston makes the question personal and specific with the word "worry". The extremely high percentages obtained by Kromm in Ljbljana are probably due in some part to the novelty of this type of research for his respondents.

There seems little use in generalizing on these findings because they are largely artifacts of the methods used. Most credence may be placed in Nashville, Sheffield, and Exeter results, where some pains were taken not to lead responses.

### Sources

In his study of definitions, Crowe found that respondents tend to think of air pollution in terms of specific polluters.<sup>176</sup> The prime culprit was identified in many studies as "industry". Almost one quarter of the Opinion Research Center's national U.S.A. sample selected the chemical industry as the main offender. Industry, this time "the mill", was also the most frequently mentioned source in Clarkston,<sup>177</sup> as was the case in St. Louis, where "business and industry" accounted for sixty-six percent of attributed causes.<sup>178</sup> In both 1959 and 1962, Degroot's

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176. CROWE, M.J. Op. cit.

177. MEDALIA, N.Z. and FINKNER, A.L. Op. cit.

178. SCHUSKY, J. 1965. Op. cit.

samples identified industry as the major contributor, with frequencies of ninety-three and eighty percent, respectively. <sup>179</sup>

Johnson read this statement to his sample: "Pollution is directly caused by big industries who are more interested in profits than in the public welfare." <sup>180</sup> Sixty-two percent agreed; twenty-eight percent did not.

In the contrasting situation in the "Eastern Block", Probald reports general agreement that industry is the main polluter. <sup>181</sup> He points out that almost all manufacturing is government controlled and that respondents prefer that offending plants be moved out of the cities rather than fined. The other study in a communist country, that of Kromm in Ljbljana, Yugoslavia, also shows a high percentage blaming industry (seventy) and very few mentions of domestic coal smoke which, objectively, is a major contributor to local pollution. <sup>182</sup>

Vehicle exhaust is the major source identified in the other studies. Williams and Bunyard's general public sample noted autos and buses as the main problem with industry in second place, a finding reversed in their public officials sample. <sup>183</sup> In Toronto, Shepherd used an open question, and found that only about one-quarter of his respondents could mention any source of air pollution. <sup>184</sup> Of these one-half noted motor vehicle exhaust.

179. DEGROOT, I. and SAMUELS, S. Op. cit.

180. JOHNSON, R.L. Op. cit.

181. PROBALD, F. Op. cit.

182. KROMM, D.E. and VIZJAK, S. Op. cit.

183. WILLIAMS, J.D. and BUNYARD, F.L. Op. cit.

184. SHEPHERD, B. Op. cit.

Barnes' sample, on the other hand, used a forced choice technique and found ninety percent chose autos, eighty-eight percent industry and forty-nine percent oil burners.<sup>185</sup> In Tucson, two-thirds of the sample considered cars to be a major part of the problem, while just under one half mentioned smelters.<sup>186</sup> McBoyle took a somewhat different tack when he asked his respondents whether they contributed personally to a pollution problem.<sup>187</sup> Forty-two percent felt that they did. Of these almost half noted their car exhaust and forty-three percent mentioned their coal fire. In Wall's Sheffield sample, a "negligible proportion" admitted their own contribution.<sup>188</sup>

Overall, there are two major sources identified, industry and traffic. The former tends to dominate the earlier studies and the latter to gain strength in more recent work. In communist countries vehicle exhaust is, apparently, considered much less of a problem. In both east and west, there is little blame placed on the activities of individual citizens. Even in the U.K., where attention under the Clean Air Acts has been focused recently on domestic sources, there is a reluctance to associate private chimneys with air pollution.

#### Responsibility for air pollution control

Response percentages for the four studies that commented directly on perceived locus of responsibility for air pollution

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185. BARNES, P.A. Op. cit.

186. SAARINEN, T.F. and COOKE, R.U. Op. cit.

187. McBOYLE, G.R. Op. cit.

188. WALL, G. Op. cit.

control are summarized in Table 4-7. The usual barriers to comparison are all present: varying sample and city sizes; sample selection; questionnaire structure and purpose; and question item structure and phrasing. The best that can be said is that air pollution is construed generally as a governmental problem, with very little responsibility placed upon the individual citizen.

#### Effort on air pollution control

A variety of approaches and question types were used to investigate satisfaction with efforts to control pollution. Rankin asked, "Do you think anything will be done about air pollution here in Kanawha Valley?"<sup>189</sup> Fifty-three percent answered yes; twenty-four percent no. This contrasts with the trend as seen by Saarinen's sample.<sup>190</sup> In that group, ninety-one percent thought air pollution was "getting worse" and not a single respondent felt the situation was improving. A more positive result was reported for Nashville where only thirteen percent rated the city's efforts inadequate.<sup>191</sup>

The single-source "mill" at Clarkston was identified as a bothersome source by seventy-eight respondents.<sup>192</sup> Of these, fifty-three percent rated the company's effort at control as "some, . . . but not as much as it should"; thirteen percent, "a great deal of effort"; and fourteen percent, hardly any effort at all.

In the opinion research study reported by Settle sixty-nine percent had no idea which industry was doing most to control air

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189. RANKIN, R.E. Op. cit.

190. SAARINEN, T.F. and COOKE, R.U. Op. cit.

191. SMITH, W.S., SCHUENEMAN, J.J. and ZEIDBERG, L.D. Op. cit.

192. MEDALIA, N.Z. and FINKNER, A.L. Op. cit.

pollution.<sup>193</sup> Eight percent of respondents chose the chemical industry and nine percent the steel manufacturers as making most effort.

Johnson's conclusion that people are disaffected with government over pollution control is based upon percentages agreeing with a series of contentious and sometimes loaded statements.<sup>194</sup>

For example:

a) "Are public officials truthful and candid in what they say about air pollution?"

Yes	14%	
usually, but not always	42%	
No	44%	(100%)

b) "Are they doing something but not enough to find solutions to air pollution?"

Yes	78%	
"doing nothing"	16%	
"doing all they can"	6%	(100%)

c) Government . . .

" . . . serves the interests of the big corporations who are polluters rather than the public interest."

Yes	50%
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In her more benign approach Schusky asks whether the following groups are doing all they should about air pollution control:<sup>195</sup>

193. Opinion Research Corporation. Op. cit.

194. JOHNSON, D.L. Op. cit.

195. SCHUSKY, J. 1965. Op. cit.



Local government	Yes	56%
County		51%
State		47%
Citizens' Groups		50%
Industry		42%

She concludes that industry is the black sheep, so far as this sample is concerned, and that "the more removed the agency (is) from the respondent, the less the respondent feels the agency is doing what it should be doing about the problem." <sup>196</sup>

Again a meaningful comparison of these data are limited due to the different pollution situations on which they are predicted. Further, air pollution would be expected to have widely differing priorities with the different governments involved. As a consequence industries in each area would be subject to a unique set of pressures regarding pollution control. The studies themselves, being at different times, constitute "snapshots" of local patterns of opinion that are constantly changing, to a greater or lesser degree, in response to local and national influences. It does, however, seem to suggest that recent years have brought a growing pessimism about pollution control in general, and about governments' abilities to effect it in particular.

#### Action on pollution control

Air pollution is, by definition, undesirable. It is, therefore, not surprising that ninety percent of the St. Louis sample feel that "something should be done" about it, <sup>197</sup> and that ninety-three

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196. Ibid. Pp. 32-33.

197. Ibid.

percent in Charleston think it is "a good thing to do something about air pollution".<sup>198</sup> Those who must carry out such action may see matters in a different light. In St. Louis, for example, seventy-two percent of the public officials sample felt that there was no pollution problem in their area. Admittedly, this schism between popular and official opinion was confined to small administrative units, while in cities, the leaders' views accorded well with general opinion.

Two studies tried to find whether respondents had been so bothered by air pollution as to move from an area on this account. Breslow's California sample showed that for twenty-one percent the presence of air pollution had, at some time in the past, been a factor in changing residence.<sup>199</sup> Medalia found that eleven percent of his sample mentioned that they had thought about moving because of air pollution, before pollution was revealed as the subject of the interview.<sup>200</sup>

Suggested actions on pollution control, over a range of studies are summarized in Table 4-8. Broadly, these show a strong reliance on "tech fix" and "legal fix". The problem is seen in its simplest form, as a matter of first making sure control technology exists, and then of making sure enforceable laws require that the technology be used.

Personal adjustments to pollution episodes were investigated in the "natural hazards" studies. The most striking feature of Tables 4-9 and 4-10 is the great difference in response frequencies

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198. RANKIN, R.E. Op. cit.

199. BRESLOW, L. Op. cit.

200. MEDALIA, N.Z. and FINKNER, A.L. Op. cit.

obtained by the two questioning techniques. Items, such as "keep children indoors", which attain ninety percent when the alternative is suggested in the question, do not receive even ten percent in the spontaneous answers. It seems likely that the "open question" elicits information that is recallable. On the other hand, suggesting alternatives seems to introduce a volatile element in which the question itself and the interviewers' presence "cue" the respondent to answer in certain ways.

These same reservations apply to Johnson's findings in the Los Angeles area. Using an agree-disagree technique, in which the "agree" item seems to be consistently associated with strong action against pollution, he obtains high response proportions for some fairly radical proposals. For example:

- a) "Seventy-nine percent favoured giving government authorities the power to shut down any plant or factory that cannot or will not meet air pollution standards;"
- b) "Seventy-four percent agreed that state gasoline and motor vehicle taxes (presently tied to highway construction) should be directed to air pollution control and balanced transportation systems;"
- c) Two-thirds of the sample would favour banning the sale of autos powered by internal combustion engine;
- d) "Seventy-six percent would support a boycott of all new automobiles for a period of time." 201

Although there may be some significance in the fact that large proportions were willing to agree with these statements, it is problematical that these findings carry any implication for

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assessment of real action potential.

Throughout these studies there is evidence of a desire to "do something" about pollution, at least on the part of the general public. There is evidence too that officials may not assign the same priority to pollution control. People do apparently take air quality into account, in some way, in assessing residential desirability. However, when considering a pollution situation, individual adjustments tend to focus on minimizing effects on self and family, rather than on personal efforts to reduce the problem itself. The suggested actions for general pollution control emphasize the role of government and the use of legal sanctions against offenders.

Many of these findings could be interpreted as artifacts of their data collection technique, particularly of the question format.

#### Utility of action on air pollution control

Views about the efficacy of action on pollution control are obscured by an apparent confusion between personal and collective action. Authors describe their samples' reactions to control measures in such terms as "a sense of helplessness", <sup>202</sup> "little they could do", <sup>203</sup> a "feeling of impotence". <sup>204</sup> Degroot interprets this frustration as a lack of confidence that anything can be done to control pollution. <sup>205</sup>

Other studies suggest a different meaning. Table 4-11 indicates that most often there is a belief that improvements can

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202. PROBALD, F. Op. cit.

203. KROMM, D.E. and VIZJAK, S. Op. cit.

204. WALL, G. Op. cit.

205. DEGROOT, I. and SAMUELS, S. Op. cit.

be made. Saarinen reports that, although no-one in his sample thought the situation was "getting better", eighty percent thought the problem could be solved, and over half felt that it would be.<sup>206</sup> Similarly, forty-two percent of Rankin's sample thought air quality would be noticeably improved in the next five years.<sup>207</sup> There is optimism about the possibilities, but frustration regarding the individual's capability of influencing their achievement.

#### Cost of pollution control

Most of the questions concerning willingness to pay for cleaner air were of the following type: "Would you pay x per year if it would mean less pollution in this area?" It is a moot point whether such responses indicate potential revenues in any way, but they may have some relevance as statements of support for a clean-up effort. It would seem that such support is indicated by Table 4-12. The possible exception is the U.S.A. survey reported by Settle,<sup>208</sup> in which the high figure of 100 dollars per person per year was suggested. It seems likely that this tactic provoked the seventy percent "nothing" response.

In a slightly different approach Rankin found that fifty-eight percent of his sample in Charleston were willing to countenance a loss of jobs in the area in order to effect pollution control.<sup>209</sup>

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206. SAARINEN, T.F. and COOKE, R.U. Op. cit.

207. RANKIN, R.E. Op. cit.

208. Opinion Research Corporation. Op. cit.

209. RANKIN, R.E. Op. cit.

## SUMMARY AND CONCLUSIONS

Studies of perception of air pollution are a modern Western phenomenon, originating in the U.S.A. and spreading from there to other countries. Only recently has this line of research been pursued to any extent in the U.K. Sample surveys offered governments a relatively inexpensive way of assessing the opinions of various groups, including the general public, with a view to allocating funds and effort where they would alleviate most discontent. This approach also permitted a "lead from behind" option if sample surveys could be used as "instant referenda" to test current strength of feeling.

The comparison of "reality" with perception is a complex matter. There is consensus across this area of research that the concern about air pollution expressed in interviews varies directly with the monitored pollution levels of the home area. In the matter of odour, human perception is the only standard. The conventional wisdom of a given time and place will influence what aspects of environment are of concern, and therefore receive attention. Any informational input, either reported or from direct experience, can alter both individual and community levels of environmental awareness.

The two basic findings relating socio-economic factors to interview responses are that young people, and the "upper class"/educated tend to be concerned about air pollution. The latter group tend to express their concern in an articulate, but aloof and impersonal way. There is little consensus about the influence of other socio-economic attributes.

Although neighbourhood pollution levels are considered to be a factor in residential assessment, this is not an important item in spontaneous problem hierarchies. There is a generally observed reluctance to attribute such negative characteristics as air pollution to the home area.

The one study that was designed specifically to test the cognitive dissonance hypothesis with reference to air pollution confirmed it. Other studies, however, have not shown the same results.

The frequency of complaints about air pollution has been found to increase with monitored pollution levels. Such records are not considered to be useful indices of annoyance because relatively few complaints are made to a record-keeping agency and, for a variety of reasons, only a small proportion of the population are willing to make a formal complaint.

The admission that air pollution damages health has been closely associated with heightened awareness and concern for the problem. There remains a schism between recognition of a general health threat and its application to personal well-being.

In most cases, pollution sources mentioned accord well with the observational context: where cars abound, traffic is noted; where factories are concentrated, industry is mentioned. There is an apparent reluctance to name private homes or autos as troublesome sources. In general, the actions of individual citizens are given minimal connection with air pollution problems.

Air pollution is conceived as essentially a government responsibility and many respondents suggest increased legal restrictions.



There is evidence in recent years of a growing pessimism about industry's sincerity and government's capacity in effecting pollution control. Yet most people are optimistic that air pollution can be overcome and most say they are willing to pay some of the costs involved.

It must be emphasized that only rather broad response patterns can be identified on the basis of these studies, because each is specific to its place, time, and methodology. Population differences further complicate comparison, although mainly this research area has been focused on the general public to the exclusion of special knowledge groups, such as doctors and engineers. Further, as the preoccupations of an era or a locality change so too would the findings of such surveys.

Such changes in thinking about air pollution are traced for the British context in the following chapters.

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PART II      HISTORICAL BACKGROUND

## Chapter 5

### THE DEVELOPING AWARENESS OF AIR POLLUTION IN GREAT BRITAIN - to 1945

#### INTRODUCTION

Awareness of "air pollution" as a serious problem possibly began with the use of coal. Early users must have discovered that the products of coal combustion could kill. Thus, as a threat to the survival of self and family, this contamination would assume importance. In addition, the acrid smell of coal smoke was much more difficult to ignore than the often pleasant scent of burning wood. Coal was, therefore, a greater threat to amenity than the fuel it supplanted.

#### THE EARLY PERIOD

In Britain, evidence of coal burning extends back to 1450 B.C., when Early Bronze Age cremations took place near Bridgend, Glamorganshire.<sup>1</sup> It is probable that the Romans used coal in the third century A.D. for the eternal flame of the Temple of Minerva at Bath,<sup>2</sup> and probable too, that they were well aware of its less pleasant aspects:

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1. FOX, Sir Cyril. 1937.  
Two Bronze Age cairns in South Wales.  
*Archaeologica* 87, 137.
  2. DOWN, C.G. and WARRINGTON, A.J.  
The history of the Somerset coalfield,  
Newton Abbot. Devon. David and Charles (no date).

On thee will rest thy father's stain,  
 Though guiltless, Roman, till thou put  
 In order shrine and mouldering fane, <sup>3</sup>  
 And statue grimed with dingy soot.

According to Galloway, <sup>4</sup> the Roman occupiers derived their coal from surface outcroppings which continued to be worked sporadically after Roman departure. Wood, being plentiful and more easily obtained than coal, remained the fuel of most Britons, with peat used where available. In the post-Roman period a marked deterioration occurred in the way fuel was burned. Roman central heating systems, with their efficient chimneys, were replaced by open fires in sunken hearth or brazier. The usual provision for smoke was a hole in the roof. Combustion was inefficient and a smoky dwelling a certainty. Fire hazard was also great, as thatched roofs and wooden structures were the rule. This remained the situation until 1066, when the Normans reintroduced stone buildings with chimneys and fireplaces. These, however, were available only to the new nobility and the wealthy, with most people continuing to burn wood or peat in the former inefficient and uncomfortable way. <sup>5</sup> William the Conqueror is credited with introducing curfew (Couvre-feu, cover fire),

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3. HORACE.  
 Odes III. 6.  
 Cudworth's translation.

4. GALLOWAY, R.L.  
 Annals of coal mining and the coal trade. 1908.  
 In DOWN, C.G. and WARRINGTON, A.J. Op. cit. P.6.

5. GOAMAN, M.  
 Food through the ages.  
 Loughborough, England. Wills and Hepworth Ltd.  
 1968. Pp. 12-20.

possibly as much to control the populace as to protect their wooden homes from fire.<sup>6</sup>

At the time of Norman conquest, the coal supply in England and Wales apparently derived from wave action which broke and washed ashore pieces from coal outcroppings.<sup>7</sup> Hence mineral coal was distinguished from charcoal by the name "sea-coal" or secol (carbo maris). The name persisted into the seventeenth and eighteenth centuries, remaining apt since the coal then came by sea from the north of England and South Wales. In Scotland, coal was dug from pits, mainly by the monks of Newbattle and Dunfermline Abbeys, and those of Holyrood House. Although some tithe records involving coal date from 1180,<sup>8</sup> the first Scottish document pertaining directly to coal was a charter granting an area in the Esk Valley east of Edinburgh to the monks of Newbattle for the purpose of mining.<sup>9</sup> This is, seemingly, the first record of coal mining in Britain.

By the first half of the thirteenth century manufacturers whose processes involved boiling or rendering had recognized the value of coal as an energy source. While domestic users still relied on wood, one industrial section of London became known as

6. Curfew.  
Encyclopaedia Britannica.  
Cambridge. The University Press. 1910-11.  
Eleventh Edition. P.639.
7. Sea-coal.  
The Oxford English dictionary.  
Oxford. Clarendon Press. Volume 9. 1961. P.319.
8. Guilty chimneys.  
National Coal Smoke Abatement Society (no date). P.3.
9. CUNNINGHAM, A.S.  
Mining in Mid and East Lothian.  
Edinburgh. James Thin and John Orr. 1925. P.1.



"Sea-coles Lane" or alternatively "Lime-burners Lane".<sup>10</sup> As population increased, particularly in London, and as the resulting demand for wood outstripped supply, more industries and some private householders turned to coal as a source of heat. Its increased use brought complaints from those who could afford sensitivity. Henry III's Queen Eleanor reportedly found Nottingham smoke so bad in 1257 that she was "unable to remain in the city and removed to Tutbury".<sup>11</sup> The summoning of the model Parliament in 1265, and its extended representation in 1295, brought to the capital an influential group, many of whom were unaccustomed to the air in what was soon to be called "the big smoke".<sup>12</sup> With typical directness Edward I ordered all manufacturers to return to the fuel they had initially used, and banned all use of coal in London during the sitting of Parliament.<sup>13</sup> One offender was executed.<sup>14</sup> Despite this punitive example the Proclamation of 1306 proved unenforceable and a Commission of Oyer and Terminer was set up in 1307 ". . . to inquire of all such who burn sea coal in the city, or ports adjoining, and to punish them for the

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10. STEER, W.R.H.  
The law of smoke nuisances.  
London. The National Smoke Abatement Society. 1938.
  11. West Bromwich clean air handbook.  
West Bromwich. 1969. P.25.
  12. BULLEN, F.T. 1897  
Cruise 'Cacholot' 25 (1901), 330.
  13. STEER, W.R.H.  
The law of smoke nuisances.  
London. The National Smoke Abatement Society.  
Second Edition. 1948. Chapter 1.
  14. EVELYN, J. 1661.  
Fumifugium.  
London. National Smoke Abatement Society.  
1933. Introduction by R. MACAULY.

first offence with great fines and ransomes, and upon the second offence to demolish their furnaces.\*<sup>15</sup> The Commission was apparently unable to enforce the wishes of the fledgling Parliament and sanguine King, and the regulation was allowed to lapse.

Although coal continued to be mined, or, more accurately, quarried in Scotland during this period, supply was short. Even when "rabbit-warren" tunnels were used to get further into the coal out-cropping and "bell" mines were developed, there was still scarcely enough fuel to provide for the abbeys' needs. Cunningham concludes: "Peat and turf - there was little wood in the country - must have continued to be the principal fuel of all classes of communities in Scotland." <sup>16</sup> Although the church's monopoly of the coal-heughs was partly broken by grants for mining to William de Prestoun (1284 at Tranent), the Earl of Orkney (estuary of Dysart, 1408), and David Wemyss (Wemyss and Methil, 1428), coal remained a precious commodity. <sup>17</sup> The pilgrim Aeneas Sylvius reported in 1435: "In Scotland I saw the poor, who almost in a state of nakedness begged at the church doors, depart with joy in their faces on receiving black stones as alms." <sup>18</sup> Lumps of coal were as valuable as coins. This supply situation persisted

15. NABARRO, G.  
Hansard. 4th February, 1955.

16. CUNNINGHAM, A.S. Op. cit. P.3.

17. CHALMERS, G.  
Caledonia 1, 723.  
Quoted from: CUNNINGHAM, A.S. Ibid. P.4.

18. SYLVIVS, A. 1435.  
Commentaries of Pius II. Translated by F.A. GRAGG.  
Northampton. Mass. Smith College Studies in History. 1912.  
Pp. 17-21.

until the enterprising Abbot James of Newbattle Abbey revised mining methods, particularly in the Esk Valley, to the extent that coal, surplus to the home market, became available for export.<sup>19</sup> To this end he was granted permission, by James V, in 1526, to construct a harbour at Prestongrange. From here the monks of Newbattle traded coal for luxuries from the continent. It seems safe to conclude from this evidence that coal consumption, or indeed the consumption of any fuel in the relatively small population concentrations at that existing in Scotland, was unlikely to have produced any great concern with smoke pollution in the outdoor environment.

#### ELIZABETHAN TIMES

Meanwhile, in the south, the combined effects of increasing urbanization and industrialization required only the personal sensibilities of Queen Elizabeth I to touch off a new period of reaction to smells and smuts in the air. The Queen followed Edward I's precedent and banned the use of coal in London during the Parliamentary sessions.<sup>20</sup> Knowledge of her intense dislike of coal smoke reportedly moved the Company of Brewers to offer to burn wood in their establishments near Westminster Palace because the Queen "findeth hersealfe greatly greved and anoyed by the taste and smoke of the sea-cooles".<sup>21</sup>

Elizabeth's lead was quickly followed by the thinkers of the age who addressed themselves to alleviating pollution from low

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19. ABBOT JAMES.  
Quoted from: CUNNINGHAM, A.S. Op. cit.

20. STEER, W.R.H. Op. cit. P.4.

21. Guilty chimneys. Op. cit.

and ubiquitous coal chimneys in London's fog-prone climate. Attention was focused on the burning properties of various fuels. Sir Hugh Platt suggested a "suitable admixture of coal and other substances which give less irritating smoke than coal alone".<sup>22</sup> Thomas Owen proposed that, despite transportation difficulties, anthracite be imported in large quantities from South Wales because of its smokeless properties.<sup>23</sup> The problem was aggravated by the now almost complete absence of wood from the London fuel market so that even the Bishop of London, a former wood supplier, was himself forced by 1598 to heat his palace with coal.<sup>24</sup> Although some anthracite from South Wales was used, Londoners increasingly burned the more polluting bituminous coals from Newcastle and Northumberland.<sup>25</sup> A similar increase in pollution was noted when Newcastle coals were introduced in Edinburgh.<sup>26</sup>

The writings of Shakespeare suggest something of the contemporary ideas about air in this period. A smoky house was a standard of unpleasantness,<sup>27</sup> while fresh air was attributed health-giving properties, as illustrated in Warwick's statement, "Give

22. PLATT, Sir Hugh,  
Jewel house.  
London. Peter Short. 1594.  
Quoted from: HART, E. (Chairman)  
The official report of the Smoke Abatement Committee.  
London. Smith, Elder, and Co. 1883. P.1.
23. West Bromwich clean air handbook. Op. cit. P.26.
24. Guilty chimneys. Op. cit. P.4.
25. Report from the committee appointed to consider the coal trade of this kingdom.  
Reports. 1785-1801 (10, 550B).
26. FENWICK, H. 1967.  
Edinburgh's Flitting.  
The Scots Magazine, New Series 87 (6), 534-543.
27. "O, he is as tedious as a tired horse, a railing wife;  
worse than a smoky house . . .".  
Henry IV, part 1. Act 3, i, 159-161.

him air, he'll straight be well", <sup>28</sup> or by Ferninand's comment on the "physics of thy health-giving air". <sup>29</sup> On the other hand, many more references suggest that air brought, often in undetectable form, both sickness and death. Thus the Lieutenant in Henry VI notes the "foul contagious darkness in the air"; <sup>30</sup> Clifford that "the air hath got into my deadly wounds"; <sup>31</sup> and Leontes imprecates, "Purge all infection from our air". <sup>32</sup> Because air posed an unseen threat to health, it was a pseudonym for perfidy, as Cressida suggests, "false as the air". <sup>33</sup> These ideas were to be given more definite shape in the next century as the miasma theory of disease.

With unerring insight Shakespeare recognizes that the assessment of air quality may be a highly personal exercise. Hamlet says,

"... this most excellent canopy, the air, look you, this brave o'erhanging firmament, this majestical roof fretted with golden fire, why, it appears no other thing to me than a foul and pestilent congregation of vapours." <sup>34</sup>

#### THE STEWART ERA

A new champion of smoke control came to the throne in 1603. During the reign of James VI emphasis was shifted from coal com-

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28. Henry IV, part 2. Act 4, iv, 116.

29. Love's Labour's Lost. Act 1, i, 228.

30. Henry VI, part 2. Act 4, i, 6.

31. Henry VI, part 3. Act 2, vi, 27.

32. The Winter's Tale. Act 5, i, 170.

33. Troilus and Cressida. Act 3, ii, 140.

34. Hamlet. Act 2, ii, 200-206.

bustion to pollution from tobacco smoke and agricultural burning.

James roundly condemned the growing use of tobacco as:

"a custom loathsome to the eye, hateful to the nose, harmful to the brain, dangerous to the lungs, and in the black stinking fume thereof, nearest resembling the horrible Stygian smoke of the pit that is bottomless . . . Herein is not only a great vanity, but a great contempt of God's good gifts, that the sweetness of man's breath, being a good gift of God, should be wilfully corrupted by this stinking smoke." 35

As well as providing this personal condemnation of tobacco, he and his Parliament passed a reasoned piece of legislation on the prohibition of heath and moor burning between March and October. 36

Its rational was given in these terms in the preamble:

"For as much as thereby happeneth yearly a great destruction of the Brood of Wildfowle, and Moore-game, and by the multitude of grosse vapours, and Clouds arising from those great Fires, the Aer is so distemper'd, and such unreasonable and unnatural storms, are ingendered, as that the Corn, and the Fruites of the Earth and thereby in divers places blasted, and greatly hindered in their due course of ripening and reaping . . ."

These two quotations from the first quarter of the seventeenth century show that even at that relatively early date there was considerable awareness of the influence of air pollution on physical and mental well-being, and of its effects on amenity and vegetation growth. Implicit, too, in the 1610 law is the realization that control of smoke must be imposed equitably over large

35. King James VI and I.  
A counterblast to tobacco.  
1604.

36. An act against the burning of ling and heath, and other moor-burning in the counties of Yorke, Durham, Northumberland, Cumberland, Westmorland, Lancaster, Darbie, Nottingham and Leister, at unseasonable times of the year. 1610.  
Reproduced in: EVELYN, J. 1661.  
Fumifugium.  
Oxford. Old Ashmolean Reprints. VIII. (1772) 1930.

contiguous areas if it is to be effective. The ideas about pollution effects and control philosophy involved in these basic statements are still being developed and are frequently rediscovered as something quite "new". For example, the basic rationale for smoke control areas under the Clean Air Act of 1956 is present in the 1610 prohibition of moor burning.

Unwillingness to tolerate the inconvenience of coal smoke continued, among the upper classes at least, into the reign of Charles I. Howes reported that, "within thirty years last the nice dames of London would not come into any house or room where sea coals were burned, nor willingly eat of the meat that was either sod or roasted with sea coal fire".<sup>37</sup> Writing in 1661, Evelyn carries on the same theme, noting that smoke "scatters and strews about those black and smutty Atomes upon all things where it comes, insinuating itself into our very secret Cabinets, and most precious Repositories".<sup>38</sup> "Yea, though a Chamber be never so closely locked up, Men find at their return, all things that are in it, even covered with a black thin Soot, and all the rest of the Furniture as full of it . . . ." <sup>39</sup>

The blockade of Newcastle in 1644 provided the reverse of an air pollution episode for London. With the supply of bituminous coal all but cut off the city lost its pall of smoke and orchards

37. HOWES. 1631.  
Quoted from: The case against smoke.  
London. National Coal Smoke Abatement Society. 1935.

38. EVELYN, J. 1661.  
Fumifugium.  
Oxford. Old Ashmolean Reprints. VIII. (1772) 1930. P.20.

39. Ibid. P.29.



were observed to yield better crops.<sup>40</sup> This striking demonstration of possible air improvement moved some London citizens to petition Parliament in 1648 for the permanent prohibition of Newcastle coal imports.<sup>41</sup> With the upheaval attendant upon civil war (1642-1649) and the subsequent protectorate (1649-1660) no action was taken. It was against this background, and with high hopes that the new sovereign, Charles II, would make up for ground lost "during these late years of our sad Confusions",<sup>42</sup> that John Evelyn prepared his monumental treatise on air pollution in London. This, being the first complete report on the city's air, deserves consideration in some detail.

His Dedication points out to Charles II how the capital's smoky atmosphere not only places his personal health and that of his subjects at risk, but also annoys such gentle persons as his sister, the Duchess of Orleans, and damages the structure of palace and furnishings alike. Visiting dignitaries, "long accustomed to the excellent Aer of their Countries" will be offended by this pall which "sullies the Glory of Your Imperial Seat".<sup>43</sup> Having thus suggested effects on the king's person, household, and office Evelyn proceeds to detail causes and to identify the villains responsible. In the latter group he includes "Brewers, Diers, Lime-burners, Salt and Soap-boylers, and some other private trades",

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40. Ibid. P.IV.

41. STEER, W.R.H. Op. cit. P.10.

42. EVELYN, J. Op. cit. P.7.

43. Ibid. P.3.

and at the same time emphasizes that the fault does not lie with "Culinary fires, which being weak, and lesse often fed below is with such ease dispelled and scattered above . . ." <sup>44</sup> It should be noted that the relative stress on control of industrial rather than domestic sources was to characterize British smoke control efforts until the end of the 19th century.

The effects with which he was most concerned were those on human health:

" . . . The Body feeded upon Meats commonly, but at certain periods and stated times, be it twice a day or oftener; whereas, upon the Aer, or what accompanies it, it is always preying, sleeping or waking . . ."; <sup>45</sup> " . . . that her inhabitants breathe nothing but on impure and thick Mist, accompanied with a fuliginious and filthy vapour, which renders them obnoxious to a thousand inconveniences, corrupting the lungs, and disordering the entire habits of their Bodies; so that Catharrs, Phthisicks; Coughs and Consumptions, rage more in this one City, than in the whole Earth besides . . ."; <sup>46</sup> " . . . but it is yet never clear of this Smoke which is a Plague so many other ways, and indeed intolerable; because it kills not once, but always, since still to languish, is worse than even Death itself. For is there under Heaven such Coughing and Snuffing to be heard, as in the London Churches and Assemblies of People, where the barking and Spitting is incessant and most importunate." <sup>47</sup>

This situation, he pointed out, was not solely due to black smoke but also to "arsenical vapour as well as Sulpher" which resulted from "This intemperate use of Sea-Coals, in great Cities". <sup>48</sup>

Evelyn was apparently the first to suggest complexity in the composition of "smoke" and to hint at synergistic and long-term debilitating effects. Although concentrating on reactions in the

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44. Ibid. P.19.

45. Ibid. Pp. 14-15.

46. Ibid. P.18.

47. Ibid. Pp. 25-26.

48. Ibid. P.27.

respiratory system ("Conduits", "Lungs", "Larynx", "Epiglottis", "Voyce"), he also suggested possible mental stress from living in a consistently dirty atmosphere "even to disturbance of the very Rational faculties".<sup>49</sup> These views must have seemed heretical indeed at a time when "the College of Physicians esteem it (smoke) rather a preservation against Infections, than otherwise any cause of bad effects . . .",<sup>50</sup> and tobacco smoke was thought to give immunity from plague, for which reason boys at Eton were, reportedly, made to smoke in school every morning.<sup>51</sup>

Evelyn was also a useful climatologist. He described how pollutants were removed from the atmosphere in precipitation ". . . so as the very Rain, and refreshing Dews which fall in the several Seasons, precipitate this impure vapour, which with its black and tenacious quality, spots and contaminates whatever is exposed to it".<sup>52</sup> Lessened nocturnal dispersion due to the absence of convective turbulence was also noted as a mechanism for returning smoke to ground level.<sup>53</sup> He observed that the worst weather condition for removal of pollution from London was a light south wind when emissions from large chimneys spread out over the city so that one journeying up the River Thames in clear air

49. Ibid. P.15.

50. Ibid. P.31.

51. DUNHILL, A.H.  
The gentle art of smoking.  
London. Max Reinhardt. 1954. P.16.

52. EVELYN, J. Op. cit. P.20.

53. Ibid. P.32.

would observe London as ". . . a Sea where no land was within ken".<sup>54</sup> The built-up area of London was, at this time, close to the river and thus on a site with extremely poor dispersion characteristics.

The fate of wind-blown smoke was also of interest to Evelyn as he noted complaints from parts of France to the southwest of England where vines were apparently damaged by "Smoakes driven from our Maritime Coasts".<sup>55</sup> He felt that such protests had influenced James VI in restricting agricultural burning in 1610. The editor of the 1772 edition observed in a footnote that annoyance with this unwanted import had by that time been recorded by a French poet.<sup>56</sup>

The concluding recommendations of *Fumifugium*, too, showed the author's understanding of the role of prevailing winds and open spaces in pollution dispersion. He advocated that large tracts of land to the east and southwest of the city be planted with fragrant flowers, bushes, and trees so that a pleasant odour might be carried into the city. The same plantings would replace tenements which had by this time encroached many of London's open spaces, including,

54. Ibid. P.22.

55. Ibid. P.38.

56. "Aspicis effosso terris carbone Britanni  
Quam male dissolvunt Frigus, quam ducitur aegre  
Spiritus; inesto nisi tabescentibus igne  
Monspeliensis opem tulerit pulmonibus aer.

Aegra salutifero potiatur ut aere tecum  
Gallia, quae foculos uno carbone Britannum  
Mox struet ad ritum, ligno caritura; gravesque  
Hauriet et Fumos, et anhelis Femina morbi;  
Ni caveant quibus est nemorum mandata potestas."

VANIERII PRAED. RUST.

apparently, St. James Park. Offensive industries such as chandlers, butchers, fishmongers, and "Charnel-houses" were to be removed from the city, along with burial grounds and "our nasty Prisons and Common Goales" because these were sources of both stench and contaminated water. Evelyn held out little hope that the latter recommendation would be effected because of the ever-present dilemma of motivation and cost versus environmental improvements: "... the Avarice of the men of this age be so far deplorable, that we may not hope for so absolute a cure of all that is offensive . . ." 57 He felt that recommendations for large scale plantings surrounding the city and more city parks did have a chance of acceptance, and of achieving improved "amoenity" and health for the citizens. A bill embodying these suggestions was presented in Parliament, but was not enacted into law. 58

#### COAL MINING

By this time, coal mining had taken on a new character. In response to consistently increasing demand during the sixteenth century Sir George Bruce had introduced the "Egyptian Wheel", or chain and bucket, system of pumping, at Culross on the western borders of Fife. With this system horse or water power could be used to solve drainage problems and allow vertical and horizontal development of mines to formerly unattainable dimensions. At the new scale of operation problems of maintaining adequate supplies of safe air for the miners became acute.

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57. EVELYN, J. Op. cit. P.43.

58. STEER, W.R.H. Op. cit.

Sinclair <sup>59</sup> discourses at some length on "Ill Air" in mines, mainly regarding a kind of "Damp", which is now recognized as carbon dioxide, and called "black damp" by contemporary miners in Scotland. Sinclair describes it in this way:

"... it hinders the burning of all combustible matter, as Candle, Coal, Pitch, Sulpher, etc. so that if you take a torch lighted, and let it down to a Sink, where the ill air is prevalent in the time, it shall straightway extinguish it . . . But the most dangerous effect is, its killing of living Creatures, whereby many persons have been suddenly killed". <sup>60</sup>

This damp had been observed following underground fires at Dysart in Fife and Fauside in East Lothian. It also occurred in some mines without fire and seemed related to wind speed and direction: "Now this Air being moved by the force of the Wind, keeps the corrupt Air from coming out, (at the face) it being stronger than the other." <sup>61</sup> Sinclair suggests air holes be constructed "for no other use, but for giving Air to the Workers," <sup>62</sup> or perhaps a giant bellows installed in the levels "for keeping the Air there in motion". <sup>63</sup> At the time of writing these practices were, apparently quite novel.

The second type of "corrupt air" which Sinclair mentions is the explosive mixture of methane gas, air, and dust now called "fire damp". He claims little knowledge of "Wild-fire" except

59. SINCLAIR, G.  
Hydrostatics.  
Edinburgh. George Swinton, James Glen, and Thomas Brown.  
1672.

60. Ibid. P.288.

61. Ibid. P.290.

62. Ibid. P.292.

63. Ibid.

that it occurs usually in coals "which are naturally full of oil".

His description of how it was dealt with is worth repeating here:

"The ordinary way by which the hurt of it is prevented, is by a person that enters, before the Work-men, who being covered with wet sack-cloath, when he comes near the Coal-wall, where the Fire is feared, he creepeth on his belly, with a long Pole before him, with a lighted candle on the end thereof, with whose flame the Wild-fire meeting, breaketh with violence, and running along the roof, goeth out with a noise, at the mouth of the Sink, the person who gave fire, having escaped, by creeping on the ground, and keeping his face close to it, till it be over-passed, which is in a moment." <sup>64</sup>

Coal production was secured at the price of abysmal working conditions for miners. Particularly in Scottish mines, women and young children were used as pack animals to bring to the surface coal cut by their men. During the 1840's vigorous efforts were made in Midlothian to enforce the legal prohibition on women and children in mines. <sup>65</sup>

Gradually, too, improvements were made in intra-mine transport. The "spiral" and "trap" staircases gave way to the "one-horse gin". In this method horse power was used to raise large baskets on ropes that all too often snapped, dashing the contents, human or otherwise, to the bottom of the shaft. Although the first apparatus in Scotland for raising coal entirely by steam power was installed in 1792, the one-horse gin continued in use in Midlothian until 1844. <sup>66</sup> Horizontal movement of coal

64. Ibid. P.294.

65. O'DELL, A.C.  
A century of coal transport - Scotland 1742-1842.  
In STAMP, L.D. and WOOLDRIDGE, S.W. (eds.)  
London essays in geography.  
London. Longmans Green and Company. 1951. Pp. 229-240.  
Pp. 230-232.

66. Ibid. P.230.



underground was facilitated by wheeled vehicles introduced at Bo'ness around 1750, and later operated on tracks. <sup>67</sup>

Outside the mines, coal was moved in tracked wagons as early as 1722 at Tranent. <sup>68</sup> Further improvements came in 1771 when the canal was opened between Carronmouth and Port Hamilton to carry coal to Glasgow, and in 1810 when the Kilmarnock and Troon Railway began operation. These developments encouraged movement of coal to ports for coastal shipment and invited increased output from the mines. <sup>69</sup>

#### CONDITIONS IN THE OTHER CAPITAL

The recorded comments of travellers do not give a pleasant impression of eighteenth century Edinburgh. It was apparently smelly, and possessed of a smoke problem, despite its relatively small population.

One visitor, a London barrister named Joseph Taylor, came to Edinburgh in 1705 while the Scottish Parliament was debating the Act of Union. Even allowing for his admitted prejudice against Scots, his descriptions give a far from inviting impression of the city.

"In the Morning the Scent was so offensive, that we were forc't to hold our Noses as we past the streets, and take care where we trod for fear of disoblising our shoes, and to walk in the middle at night, for fear of an accident on our heads". <sup>70</sup>

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67. Ibid. P.232.

68. Ibid. Pp. 235-237.

69. Ibid. Pp. 238-240.

70. TAYLOR, J.  
A journey to Edenborough in 1705.  
Edinburgh. William Brown. 1903. P.134.

Not only strangers were revolted by Edinburgh's sanitary arrangements. Some years earlier, a former Baillie of the city, Sir Alexander Brand, had pointed out the capital's "nastiness" was a source of embarrassment to Scottish travellers abroad. He offered to undertake removal of "the whole muck of Edinburgh" and to sweep every morning "the whole Streets, Closes, Courts, and Turnpyks" in exchange for £500 Sterling of which he would donate £400 to the poor.<sup>71</sup> The suggestion was apparently not acted upon, for Defoe comments on his visit of 1769 that it was "as if the People were not as willing to live sweet and clean as other Nations, but delighted in Stench and Nastiness . . ."<sup>72</sup> Similar opinions of the city at this time were expressed by Johnson,<sup>73</sup> Wesley,<sup>74</sup> and Arnot.<sup>75</sup>

Local coal was of good quality, accessible, and relatively cheap. For these reasons, a strong tradition of preference for this fuel developed.<sup>76</sup> The Statistical Account estimated coal

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71. BRAND, Sir Alexander.  
Overture for cleansing of the streets.  
Quoted from: TAYLOR, J. Ibid. Pp. 130-131.
72. DEFOE, D.  
A tour through Great Britain (1769).  
London. Peter Davies, 1927. Volume 2. P.710.
73. JOHNSON, S.  
A Journey to the Western Islands of Scotland (1773)  
In LASCELLES, M. (ed.)  
The Yale Edition of the works of Samuel Johnson. Volume IX.  
New Haven and London. Yale University Press. 1971.  
Pp. 22-23.
74. WESLEY, J.  
On his visit to Edinburgh, May 1761.  
Wesley's Journal. Volume 4. P.452.
75. ARNOT, H.  
History of Edinburgh.  
Edinburgh. W. Creech. 1779. P.352.

consumption for Edinburgh at approximately 180,000 tons per year in 1793. This was almost exactly the amount used in 1967 for domestic purposes, according to National Coal Board figures. <sup>77</sup>

Edinburgh's smoke problem, which led to the appellation "Auld Reekie", was not solely a reflection of the amount of coal consumed. The population was concentrated in tenements lining the High Street, often to a height of ten stories. In 1700, the royal burgh comprised only one hundred thirty-eight acres, but had a population of 25,000, <sup>78</sup> for a density of one hundred eighty people per acre. In almost all houses "lighting up" occurred in the morning at about seven o'clock, and again in the late afternoon for preparation of the evening meal. Thus, there was a marked periodicity of smoke emission. The topography of Edinburgh lent itself to accumulation of smoke in natural pockets, often accentuated by the built environment, and to observation of such concentrations from the seven major hills in the area.

#### THE RISE OF TECHNOLOGY

During the eighteenth century technological change markedly altered the use of coal. In 1705 Newcomen patented a steam engine. Within fifteen years the first of these machines in Scotland was installed at a pithead in Elphinstone, Stirlingshire. <sup>79</sup> Although some attention had been paid to source controls

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76. CROSBIE, A.J., CROSBIE, N.J., and DICK, J.H.A.  
Air pollution in Edinburgh. Part 1 M.S.S. 1968. P.9.

77. Ibid.

78. Ibid. P.13.

79. CUNNINGHAM, A.S. Op. cit.

on furnace smoke in the seventeenth century,<sup>80</sup> it was not until the end of the eighteenth century that the combustion process was sufficiently well understood to allow an effective smoke abatement device to be patented,<sup>81</sup> and the mechanical stoker to be constructed.<sup>82</sup> The man principally responsible for promulgating this improved understanding was Benjamin Franklin. In 1744, he published, without patent, the design for the "Pennsylvania Chimney and Fire-Place" (Figure 5-1), along with an account of its operational advantages.<sup>83</sup> These included a fuel saving of up to two-thirds on the then current open grate. This was accomplished by more effectively removing the heat from the smoke, and by the low arch and tapered front which forced the smoke to pass through the flame, thus burning a great part of it. Franklin's own account of smoke consumption, contained in a letter to Matthew Boulton in 1766, bears quotation:

"I would only repeat to you the hint that I gave of fixing your grate in such a manner as to burn all your smoke. I think a great deal of fuel would then be saved, for two reasons. One that smoke is fuel, and is wasted when it escapes unflamed. The other, that it forms a sooty crust on the bottom of the boiler, which crust not being

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80. JUSTEL. 1686.  
An account of an engine that consumes smoke.  
Paper presented before the Philosophical Society, London.  
Cited in: CHAMBERS, L.A. 1972.  
Classification and extent of air pollution problems.  
In SMITH, L. (ed.)  
The ecology of man: an ecosystem approach.  
London. Harper and Row, Publishers. 1972. Pp. 284-294.
81. WATT. 1785.
82. ROBERTSON. 1800.
83. FRANKLIN, B. 1744.  
An account of the new invented Pennsylvanian fire-places.  
In COHEN, I.B.  
Benjamin Franklin in his contribution to the American tradition. Indianapolis and New York. The Bobbs-Merrill Co. Inc. 1953. Pp. 211-224.

a good conductor of heat, and preventing flame and hot air coming into immediate contact with the vessel, lessens their effect in giving heat to the water. All that is necessary is to make the smoke of fresh coals pass descending through those that are already thoroughly ignited." <sup>84</sup>

Despite the presence of this information, and the promised savings in fuel and smoke, the penchant of the British people for open fires with visible flames militated against the introduction of closed "Franklin-type" stoves.

This preference did not arise suddenly. From the 1300's coal had been available, but expensive, due to the small quantity mined and the transport costs. The coal supply improved with the engineering achievements of Bruce and the export restrictions imposed by Mary in Scotland, Elizabeth in England and maintained by James VI and Charles I. All during this time wood became an increasingly scarce fuel. But coal had its problems, too. The large flues constructed for wood fires did not draw coal smoke well and rooms reeked with its odour. The first raised grate was used in England in the reign of Queen Anne (early 1700's). <sup>85</sup> This, coupled with a constriction of fireplace openings did much to alleviate the smoky room problem. Yet, coal remained expensive. It had to be transported in ships, barges and inland by carts for sale, to all but the very wealthy, in small amounts. A warm fire was a luxury. Even the rich used coal mainly in living-rooms, continuing to cook, in the traditional way, with wood. When coal did become available to a larger part of the population they wished to burn it in the

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84. This quotation appears in a letter from Mr. R.B. Hovey to the Manchester Guardian. It is reprinted in *Clean Air* 1 (1), 36. 1929.

way that had for generations been associated with the comfortable life of the upper classes. Such traditions die hard.

To conform with this preference, Cutler developed a "smokeless domestic grate" which he patented in 1815. Indeed, the awareness that domestic coal fires were a source of smoke and wasted fuel was apparently in vogue in Britain at the beginning of the nineteenth century.

The compilers of the Encyclopaedia Britannica, published at this time in Edinburgh, had not felt it necessary to include "smoke" in their first three editions. The fourth, however, in 1810, briefly defined the term as an unpleasant "elastic vapour" given off during burning and was "often prejudicial to health".<sup>86</sup> The article continued: "As our masons at present seem to have a very imperfect knowledge of the manner in which chimneys ought to be built, we can hardly perform a more acceptable service to the public than to point out the manner in which they ought to be constructed . . ." The following discussion of siting, size, height, and ventilation of chimneys quoted liberally from Franklin. In the same decade, in the south, Count Rumford said that he never "viewed from a distance the black cloud of unconsumed coal which hangs over London without wishing to be able to

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85. HOLE, C.  
English home-life.  
London. B.T. Botsford Ltd. 1947. Pp. 100-101.

86. Smoke.  
Encyclopaedia Britannica.  
Edinburgh. Archibald Constable and Co.  
4th Edition. Volume 19. 1810. Pp. 415-423.

compute the immense number of chaldrons of coal of which it is composed".<sup>87</sup> Although awareness of domestic fires' contribution to smoky urban air was increasing, industrial sources were still considered the major offenders.

In 1819, attention turned again to domestic problems. After the Napoleonic wars a Parliamentary Committee was established to "Enquire how far persons using steam engines and furnaces could erect them in a manner less prejudicial to public health and comfort".<sup>88</sup> The evidence given before this Committee indicated that industrialists, particularly those who operated bleaching greens near their chimneys, had been actively seeking to effect smoke control over the preceding twenty-five years.<sup>89</sup> One Josiah Parkes, a worsted manufacturer from Warwick, had evolved an adaptation, costing £30 per boiler, which required about one third less coal than normal. It produced smoke only during the first hour of operation, and that less opaque than formerly. He noted that "the Newcastle coals make a great deal more smoke and less flame than the Staffordshire, and therefore the destruction of the smoke becomes a much more difficult object . . ."

87. HART, E., Chairman.  
The official report of the Smoke Abatement Committee.  
London. Smith, Elder and Co. 1883. P.1.
88. Report from the Select Committee appointed to inquire how far it may be practicable to compel persons using steam-engines and furnaces in their different works to erect them in a manner less prejudicial to public health and public comfort.  
Reports. 1819 (8, 574).
89. TAYLOR, M.A., Chairman.  
On steam engines and furnaces.  
Reports. 1820 (2).



Other practitioners of smoke consumption <sup>90</sup> found that an increase in fuel consumption of about ten percent attended their efforts, and that a highly skilled stoker was essential to any success. Although the report concluded that smoke control was, at that time, a practical proposition, no action was apparently taken until a new study commission took evidence in 1843.

This committee, under the chairmanship of W.A. MacKinnon, was to assess:

- a) the practicability of preventing smoke nuisance "arising from Fires or Furnaces";
- b) whether such action, if practical, was advisable, "as so doing might interfere with the property or interests of manufacturers, or the proprietors of furnaces";
- c) whether legislation was required. <sup>91</sup>

These terms of reference illustrate two of the four enduring cornerstones of the national government's approach to smoke control:

- a) the law must not require technical feats impossible at the time;
- b) industry must not be handicapped by the costs of pollution abatement.

The remaining two, that legislation be permissive on local authorities and that enforcement be by consultation rather than coercion, had already been inaugurated at Leeds, as was reported

90. WAKEFIELD, Manchester; ROBERTSON, Glasgow; PHIPSON, Birmingham.

91. MACKINNON, W.A., Chairman.  
Report from the Select Committee on Smoke Prevention.  
Reports. 1843 (7, 583).

in evidence by William Beckett, M.P. <sup>92</sup>

Beckett recounted that concerned citizens at Leeds had convened a committee of experts on methods of smoke control and published their proceedings. As a result a clause was inserted in the Leeds Improvement Act of 1842 "compelling the manufacturers of Leeds to adopt the best mode then in existence for the consumption of smoke". <sup>93</sup> A marked improvement in air quality ensued although no use was made of the legal powers.

The following witness, a medical doctor named Reid, pointed out that removal of domestic coal smoke posed no technical problems. The difficulties were behavioural:

"... there is commonly in this country so great a desire to see the fire, that though perfectly practicable, there is generally an objection to any arrangement that supercedes it; but in Russia and Sweden and other countries, by the furnaces which they are in the habit of employing they obtain a most perfect warmth in a very superiour manner to what is obtained in this country generally, with far less production of disease, and with more comfort to inhabitants."

Although desire to see the flames was undoubtedly a factor in the British preference for open fires there is evidence that the ventilation afforded by an open grate was also valued. For example, Queen Victoria explained the "reactionary" spirit of the Russian people as due to a lack of fresh air during winter when their stove-heated houses were "sealed up". <sup>94</sup> There was even a suggestion by Sir James Clark, physician to

92. Ibid.

93. Leeds improvement act. July 16, 1842.  
Local Acts. 5 and 6 Victoria. C.104.

94. LONGFORD, E.  
Victoria R.I.  
London. Pan Books Ltd. 1964. P.118.

the Queen, that a giant bellows be installed to force additional fresh air into Buckingham Palace. He and his friend, Arnott, apparently believed that, given proper ventilation, people could live for several hundred years.<sup>95</sup> Victoria was, reportedly, amused.

By accident of climate, the British have been able to indulge their preferences for visible flames and fresh air while colder lands were forced to more efficient fuel use. Yet, it is striking that these views were expressed 100 years after Franklin's design for the Pennsylvania stove was published in Britain, and that it would be a further 100 years before any action was taken to curb pollution from the domestic fire.

Evidence was also taken by the Committee on the problem of stench arising from London's sewers.<sup>96</sup> They were informed that a foul air from the sewers around the House of Commons, which formerly entered the Chamber, was, at that time, being burned at a shaft in Old Palace Yard.<sup>97</sup> This burning drew fresh air into the sewers and precluded a back flow of offensive odour into homes and streets of the area, a nuisance which had formerly been a great disturbance during a prolonged east wind. The Committee recommended that such burning stations be established more generally.

Mr. G.F. Muntz, an industrialist, warned the Committee that, "In the present state of trade, when every shilling is an object

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95. Ibid. P.255.

96. MACKINNON, W.A. Op. cit.

97. Ibid. P.35.

to the manufacturers, competing as they are with the Continent, it might be considered a hardship to force upon them such an outlay for such a purpose under such circumstances". <sup>98</sup>

Despite his words the Committee recommended that smoke control for furnaces and steam engines was both practical and immediately desirable. Although hopeful that domestic fires could also be smokeless, it was recommended that they not be regulated in "the present state of knowledge". In a somewhat surprising concluding paragraph the Report charges the government to bring in legislation on smoke control "early next Session", otherwise the Committee itself, "as being the necessary result of the complete and strong conviction to which they have come by the presentation of this inquiry", will themselves introduce a bill. Such a bill was presented to Parliament by members of the Select Committee in 1844 <sup>99</sup> and went, after receiving a new title, <sup>100</sup> to third reading. Although it was not enacted into law, a clause was inserted in the Railway Consolidation Act of 1845 requiring engines to "consume their own smoke". <sup>101, 102</sup>

Two further reports were submitted by the Committee. The

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98. Ibid. P.5.
99. A bill to prohibit the nuisance of smoke from furnaces or manufacturers.  
Bills. 1844 (4, 374).
100. An act to abate the nuisance of smoke from certain furnaces and chimneys.  
Bills. 1845 (6, 311).
101. Railway clauses consolidation act. 1845.  
Public General Statutes. 8 Victoria. C.20.
102. An act for consolidation in one act of certain provisions usually inserted in acts authorizing the making of railways in Scotland. 1845.  
Public General Statutes. 8 Victoria. C.33.

first <sup>103</sup> advised that only "Furnaces used for the generation of Steam for the working of Stationary Steam Engines" should be regulated by law, but in these cases "the Occupier of the property, or the Person employed in the care of the Furnaces" should be subject to penalty as well as the owner. The second, <sup>104</sup> advocated exemption for furnaces connected with the manufacture of "Iron, Copper, and Coal Works and with Distilleries". The 1844 bill was presented again <sup>105</sup> with these revisions incorporated, but it was not enacted. In 1846, a new study commission was set up; the preamble of its report is most enlightening. <sup>106</sup>

The previous bill was apparently withdrawn in the face of complaints from industries who felt they were likely to be affected, and on the understanding that the government would itself proceed with legislation. The commission chairmen, De La Beche and Playfair, pointed out:

"that while on the one hand these fires and furnaces from which a discharge of smoke can be prevented, should be brought within the provisions of legislative enactments, the progress of important branches of our national industry should not, on the other, be impeded".

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- 103. Report from the Select Committee on Smoke Prevention. Reports. 1845 (13, 289).
  - 104. Report from the Select Committee on Smoke Prevention. Reports. 1845 (13, 489).
  - 105. A bill to prohibit the nuisance of smoke from furnaces and chimneys. Bills. 1846 (4, 371).
  - 106. Smoke prohibition: Report addressed to Viscount Canning by Sir Henry Thomas De La Beche and Dr. Lyon Playfair, upon the means of obviating the evils arising from the smoke occasioned by factories and other works situated in large towns. Reports. 1846 (4, 371).

It was noted that a number of cities, including Derby, Leeds, Manchester, and Birmingham already had Local Acts prohibiting smoke and that "smoke is a public nuisance under the common law, and, as such may be proceeded against by indictment". The report then described the difficulties in administering the existing common and statute laws regarding smoke control.

The difficulty in replying on common law to effect smoke control was that:

"The persons immediately subject to the nuisance of a smoky factory, for example, are in many cases dependent upon that factory for employment, or they are of a class which does not perceive any great prejudice to itself from the circumstance. These persons have been so long accustomed to its effects, that they have, by habit, become reconciled to that which might, at first, have been considered a nuisance, and they do not perceive the ultimate moral injury arising from want of cleanliness."

Thus, even at this relatively early stage it was realized that awareness of air pollution was a highly subjective matter.

The various efforts at statute law had all suffered from enforcement problems. Some had inadequate observation procedures, others were loosely worded. The meaning of "black" smoke had caused particular difficulties. In other cases the magistrates were themselves industrialists and refused to accept a smoke inspector's evidence as sufficient grounds for conviction. Penalties, too, caused confusion, as some were ridiculously low, others impossibly high. The onus of proof in most cases lay with the complainant who had to demonstrate that smoke could be consumed in the offending factory. Laws requiring all industries to operate smokelessly ignored the absence of practical means to effect this objective. When sufficient air was injected to remove smoke, it at the same time lowered furnace

temperatures below those necessary for iron works, potteries, and glass works. Other "special" industries, such as the copper works at Swansea, raised problems very different from those involving smoke from fuel. Similarly, social practices and inadequacies of technology precluded immediate control of domestic sources.

The series of reports, from 1843 to 1846, provide a significant insight into prevailing attitudes and awareness in this period of rising social conscience and increasing urban ills. In the almost 200 years since Evelyn, smoke control had progressed from a solely upper class concern to become a problem recognized, too, by the practical men of the industrial upper-middle class, many of whom saw opportunities to extend their businesses by producing smoke-consuming adaptations. Dirt in this period was equated with evil. Therefore, to clean up the mess was morally right. A somewhat paternalistic attitude toward the apathetic workers and lower classes, particularly obvious in the 1846 report, is perhaps understandable in these days of Empire, and not very different from that encountered today. Although flashes of local enthusiasm for smoke control had occurred, as in Leeds in the early 1840's,<sup>107</sup> this was not yet in any sense a popular cause. The upper classes, with leisure time and financial independence, were to remain the prime movers in anti-smoke organizations for another hundred years. Although not directly mentioned in the reports, the

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107. Leeds improvement act. Op. cit.



greatest impetus to legislation was the rising awareness of preventative medicine and public health through hygiene. Evelyn's warnings in that regard had finally penetrated the public consciousness.

The long-awaited legislation, when it came, applied only to England and Wales.<sup>108</sup> It provided that sewers be covered and fitted with traps to prevent stench, and that streets be regularly cleansed, with scavengers employed to collect rubbish. Annoyance or threat to health occasioned by stagnant water, dung accumulations or offensive industries, such as knackers yards or slaughter-houses, would be ordered removed by the Commissioners responsible for administration of the Act. Ventilation standards were established for public and rented accommodation, and maximum numbers of guests set for each lodging house. All new furnaces used in "working engines by steam" had to be "constructed as to consume the Smoke arising from the Combustibles". Existing furnaces were given two years to make alterations.

Parallel Scottish legislation, with regard to smoke control in cities and royal burghs having over 2000 of a population, was passed in 1847,<sup>109</sup> and amended in 1865 to apply to all burghs of that size.<sup>110</sup> Most other provisions of the Town Improvement Clauses Act, with the exception of those dealing with ventilation

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108. The towns improvement clauses act.  
Public General Statutes. 10 and 11 Victoria. C.34.
109. The smoke nuisance (Scotland) act. 1857.  
Public General Statutes. 20 and 21 Victoria. C.73.
110. The smoke nuisance (Scotland) act. 1865.  
Public General Statutes. 28 and 29 Victoria. C.102.

in buildings, were contained in the Public Health (Scotland) Act, 1897.<sup>111</sup> In 1892, the Police Burgh (Scotland) Act<sup>112</sup> extended regulations of construction and operation of furnaces to all burghs with the exceptions of Edinburgh, Glasgow, Dundee, Aberdeen, and Greenock. This Act carried exemptions for mines and certain metallurgical processes. A more stringent law, the Glasgow Act, 1892,<sup>113</sup> applies to all furnaces, whatever their use. Scottish legislation followed the English in admitting the "best practical means" defence, but avoided the term "black smoke", preferring "dense smoke" instead. The result was little different. In practice, a chart developed by Professor Ringelmann of France in the early 1900's<sup>114</sup> came to be used by both.

By the middle of the nineteenth century London's rising population and increasing coal consumption, both in homes and industry, had combined with its natural climate to produce a dangerous atmosphere over the city. Dickens described, in his novel *Bleak House*, a provincial's first encounter with London air:

"A young gentleman who had inked himself by accident, addressed me from the pavement, and said, 'I am from Kenge and Carboy's, miss, of Lincoln's Inn.'

'If you please, sir,' said I.

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- 111. Public health (Scotland) act. 1897.  
Public General Statutes. 60 and 61 Victoria. C.38.
  - 112. Police burgh (Scotland) act. 1892.  
Public General Statutes. 55 and 56 Victoria. C.55.
  - 113. Glasgow Police (extra powers) act. 1892.  
Local Acts. 55 and 56 Victoria. C.15.
  - 114. GILPIN, A.  
Dictionary of fuel technology.  
London. Newnes-Butterworths. 1969. P.199.

He was very obliging; and as he handed me into a fly, after superintending the removal of my boxes, I asked him whether there was a great fire anywhere? For the streets were so full of dense brown smoke that scarcely anything was to be seen.

'O dear no, miss,' he said. 'This is a London particular.' I had never heard of such a thing.

'A fog, miss,' said the young gentleman.

'O indeed,' said I." <sup>115</sup>

Given this impetus, it is not surprising that London developed more stringent controls than those applied nationally.

From 1851 the Commissioners of Sewers had proceeded against smoke nuisance under the City of London Sewers Act of that year.

At the same time burials were prohibited within the city. <sup>116</sup>

It was considered necessary to provide new legislation to control the structure and operation of furnaces, not only in the city, but also on the River Thames between London and Richmond Bridges. <sup>117</sup>

Enforcement of this prohibition of opaque smoke was entrusted to the police, who had powers of search, and the support of an engineer to instruct offenders on the best means of removing their smoke. This pioneer effort with the twin prongs of regulation and expert advice was to prove valuable later in framing the national Alkali Acts.

The initial exemption of glass and pottery works was lifted

115. DICKENS, C.  
Bleak house. 1852. Chapter 3.

116. An act to amend the laws concerning the burial of the dead in the Metropolis. 1852.  
Public General Statutes. 15 and 16 Victoria. C.85.

117. Smoke nuisance abatement (Metropolis).  
Bills. 1852-53 (6, 873).

in 1853,<sup>118</sup> and bills were subsequently introduced to extend the "smokeless" area of the Thames,<sup>119</sup> and to exempt bakers from the 1853 Act.<sup>120, 121</sup> Although the latter amendments were not enacted there was considerable agitation on the part of bakers for exemption.<sup>122</sup>

As the concept of air pollution evolved, "smoke" became differentiated into two classes: the products of fuel combustion; and "noxious vapours" from industrial processes. It was the latter group, identified by De La Beche and Playfair,<sup>123</sup> that the Alkali Acts sought to control.

The first of these Acts, in 1853,<sup>124</sup> dealt with factories which produced "muriatic acid gas". It established an inspectorate with whom all such manufacturers must register. These men were empowered to visit the works to ensure a minimum of ninety-five percent efficiency in recovery of the acid gas.

118. Smoke nuisance abatement (Metropolis) Act, amendment. Bills. 1853 (6, 156).
119. Smoke nuisance abatement (Metropolis). Bills. 1847-48 (4, 146).
120. Bakehouses. Bills. 1870 (1, 6).
121. Bakehouses. Bills. 1872 (1, 54).
122. "The Scotsman" of April 8, 1872, reports: "London Bakers and Smoke The bakers of London held a meeting last night, and passed a resolution affirming that, after 20 years' trial, they had found it impossible to comply with the Smoke Nuisance Act and claimed exemption."
123. Smoke prohibition: report. Op. cit.
124. Alkali act. 1863. Bills. 1865 (1, 135).

The initial Act was renewed after five years,<sup>125</sup> and was amended in 1874<sup>126</sup> to include copper mines and the production of noxious gases from sulphuric, sulphurous acid, and nitric acids; other oxides of nitrogen; sulphurated hydrogen and chlorine. These Acts were replaced in 1881<sup>127</sup> by a similar regulation which greatly extended the list of "scheduled industries" to include among others cement and salt works. (List 5-1)

It also set maximum emission concentrations allowable for acid gases of sulphur and nitrogen, in the same way that the 1874 amendment had for muriatic acid. Further industries were brought under the Alkali Act in 1892. (List 5-2) This law stood until 1906 when a new version was drafted with powers to keep abreast of industrial development.<sup>128</sup> This involved, mainly, extensions of the "schedule". (List 5-3) In 1951, the Secretary of State for Scotland received powers to extend the schedule or to send inspectors to any suspected factory.<sup>129</sup>

The bare bones of the Alkali Acts belie their real strength, which lies in their method of enforcement - in their spirit rather than their letter. The genesis of this spirit may be traced to the personal stamp of the first Chief Alkali Inspector,

- 125. An act to make perpetual the Alkali act, 1863.  
Bills. 1867-68 (1, 153).
- 126. An act to amend the Alkali act, 1863. 1874.  
Public General Statutes. 37 and 38 Victoria. C.43.
- 127. Alkali, etc. works regulation act. 1881.  
Public General Statutes. 44 and 45 Victoria. C.37.
- 128. Alkali, etc. works regulation act. 1906.  
Public General Statutes. 6 Edward VII. C.14.
- 129. Alkali, etc. works regulation (Scotland) act. 1951.  
Public General Statutes. 14 and 15 George VI. C.23

Dr. Angus Smith. His inspectors acted to some extent as honest brokers between the public and industry. Yet, at the same time they were experts in industrial technology. In these early days, individual companies could not, or would not, afford such expert advice. Through the operation of the Act it became available to them. In the tradition of the early Leeds regulations and the Metropolitan Acts, the inspectors first sought the offender's cooperation in a mutual effort to achieve compliance. The inspector offered expertise achieved through his training and in efforts to control emissions from other factories. Only where cooperation failed would the power of the courts be used. Inspectors tended to evaluate the overall impact of a factory emission on its surroundings and relied to a large extent on complaints to initiate investigations. In general, they were tolerant of "teething troubles" from new plants and equipment. These traditions of cooperation and conciliation, with emphasis on attaining "the best practicable means of control" at any given time, come down to the present day. <sup>130</sup>

As the Alkali Acts developed during the third quarter of the nineteenth century, more information was becoming available on the operation of smoke abatement laws. In 1855 <sup>131</sup> and

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130. The first fifty annual reports of the Chief Alkali Inspector were published as Parliamentary Papers, thereafter by the government departments responsible: successively, Ministry of Health; Ministry of Housing and Local Government; Ministry of Environment.

131. Smoke nuisance abatement (Metropolis). Accounts and Papers. 1855 (53, 270).

1861, <sup>132</sup> summaries of convictions for smoke offences were prepared for London. Also in 1855, the government published a digest <sup>133</sup> of smoke consuming methods, followed in 1866 by a table showing smoke control laws existing throughout the country. <sup>134</sup> (Table 5-1) During this period government publications were the main source of information on smoke abatement.

Despite the government's lead in education and legal constraints, air quality was apparently little improved. Biting literary comment continued, with Ruskin perhaps the most caustic critic. He described a midsummer morning in 1871 at Matlock, Derbyshire, in this way:

"For the sky is covered with grey cloud; - not raincloud but a dry black veil, which no ray of sunshine can pierce; partly diffused in mist, feeble mist, enough to make distant objects unintelligible, yet without any substance, or wreathing, or colour of its own . . . It looks partly as if it were made of poisonous smoke; very possibly it may be: there are at least two hundred furnace chimneys in a square of two miles on every side of me." <sup>135</sup>

In 1873, from Brantwood he wrote,

"It is a bright morning, the first entirely clear one I have seen for months; such, indeed, as one used to see, before England was civilized into a blacksmith's shop . . . and as, perhaps, our children's children may see often enough again, when their coals are burnt out, and they begin to understand that coals are not the source of all

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- 132. Smoke consuming furnaces.  
Accounts and Papers. 1861 (50, 550).
  - 133. General Board of Health.  
A digest of information obtained with regard to the operation of inventions for the consumption of smoke.  
Accounts and Papers. 1855. (61).
  - 134. Smoke.  
Accounts and Papers. 1866 (60, 218).
  - 135. RUSKIN, J.  
Fors Clavigera. Volume 1.  
Sunnyside, Oprington, Kent. George Allen. 1871. Pp. 1-3.



power Devine and human." 136

He not only railed against the coals, but also against the irresponsible self-interest of industrialists and the difficulties in recovering "nuisance" damages in the courts. This is how he described a situation in industrial England:

"I want to tell you one little fact that I heard the other day that made me furious. It will make a long letter, but please read it. You have heard of ———— - the vilest spot in all the earth, I am sure, and yet they are very proud of it. It is all chemical works, and the country for miles round looks as if under a curse. There are still some farms struggling for existence, but the damage done to them is very great, and to defend themselves, when called upon to make reparation, the chemical manufacturers have formed an association, so that if one should be brought to pay, the others should support him. Of course, generally, it is almost impossible to say which of the hundreds of chimneys may have caused any particular piece of mischief; and further frightened by this coalition, and by the expense of law, the farmers have to submit. But one day, just before harvest time this year, a farmer was in his fields, and saw a great stream, or whatever you would call it, of smoke come over his land from one of these chimneys, and, as it passed destroy a large field of corn. It literally burns up vegetation, as if it were a fire. The loss to this man, who is not well off, is about £400. He went to the owners of the works and asked for compensation. They did not deny that it might have been their gas, but told him he could not prove it, and they would pay nothing. I dare say they were no worse than other people, and that they would be quite commended by business men. But that is our honesty and this is a country where there is supposed to be justice. These chemical people are very rich, and could consume all this gas and smoke at a little more cost of working." 137

The hardship was great and the problem serious, but great and serious too were the difficulties of framing control legislation. Not only was this technically difficult, but also there was an ambivalence about regulation which arose from the

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136. RUSKIN, J.  
Fors Clavigera. Volume 3.  
Sunnyside, Oprington, Kent. George Allen. 1873. P.1.

137. Ibid. Pp. 16-17.

fear that excessive controls would kill the industrial goose that laid the golden eggs of employment and Empire.

The difficulties in effecting legal controls were at no time greater than during this era of laissez-faire economics. Yet, some progress was made. The Nottingham Improvement Act, 1874<sup>138</sup> circumvented the problem of defining "black" smoke, which still bedevilled smoke control laws. It simply stated that all engines or furnaces must be constructed and operated so as to cause no smoke nuisance. If such nuisance occurred due to negligent operation, the employee responsible could be prosecuted. This law, apparently, worked well, but its lessons were ignored in the Public Health Act, 1875,<sup>139</sup> which applied to all England and Wales with the exception of those cities having their own "improvement laws". Although the Act required furnaces to be "smoke-consuming" and "nuisance" to be avoided by careful operation, it added the now standard phrase "as far as practicable".<sup>140</sup> This admitted a technical defence which made conviction unlikely.

Efforts were also made to firm up the regulations governing emissions from locomotives. The Act of 1878<sup>141</sup> shifted the burden of proof from the accuser to the defender, so that train

138. Nottingham improvement act. 1874.  
Public General Statutes. 37 and 38 Victoria. C.194.

139. Public health act. 1875.  
Public General Statutes. 38 and 39 Victoria. C.55.

140. Ibid. Section 91, 5-57.

141. Highways and locomotives amendment act. 1878.  
Public General Statutes. 41 and 42 Victoria. C.77.

operators had to show that their machines were constructed and managed so as to consume their smoke. In 1905, a regulation on sparks and cinders was passed,<sup>142</sup> which, in 1930, was extended to "visible vapour, sparks, ashes, and grit" from other vehicles as well.<sup>143</sup> This legislation failed due to inadequate enforcement procedures, insofar as prosecution depended most often on a snap judgement by a single policeman observing a rapidly moving vehicle.

Toward the end of the nineteenth century certain "improving societies" showed interest in cleaner air.<sup>144</sup> Mr. Ernest Hart of the National Health Society and Miss Octavia Hill of the Kyrle Society instigated a joint "Smoke Abatement Committee" whose main purpose was to organize an exhibition of the latest devices for smoke control.<sup>145</sup> On November 30, 1881, the demonstrations and lectures were commenced with an official opening at Albert Hall. The South Kensington Exhibition attracted 116,000 visitors from Europe, the Commonwealth, and many British cities. There was, however, no mention of an official delegation from any Scottish city. The project was considered so successful that, on closing, it was moved to Manchester. The Committee's report contained summaries of both exhibits and about 150 pages of drawings illustrating the various devices shown (e.g. Figure 5-2). Involvement in the Exhibition led to establishment of the

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142. Railway fires act. 1905.  
Public General Statutes. 5 Edward VII. C.111.

143. Road traffic act. 1930.  
Public General Statutes. 20 and 21 George V. C.30.

144. HART, E. Op. cit.

145. Ibid. P.2.

National Smoke Abatement Institution, a propagandist organization with the twin objectives of promoting fuel conservation and encouraging smoke control. Enthusiasm was so short lived that Hart had to abandon his organization of a repeat exhibition in 1885 due to lack of support. <sup>146</sup>

Further insight into attitudes during the 1880's is provided by the minutes of evidence of the Select Committee of the House of Lords on Smoke Nuisance Abatement. <sup>147</sup> The Committee was considering a bill that would give local authorities power to require domestic fires in their jurisdictions to be operated smokelessly. It was agreed that control of domestic smoke was practical from a technical point of view. Discussion centred around the behavioural implications of such a move. As Lord Balfour of Burley put it, "Some people are obstinate enough, and a good many of them like coal better than coke." <sup>148</sup> Witness Coles pointed out that it was not necessary to switch to coke. If householders could be persuaded to light their fires from the top rather than the bottom, a significant decrease in smoke would result. Lord Balfour asked, "Are you able to refer me to any evidence which would lead me to believe that the general public opinion of the metropolis is educated up to

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146. DES VOEUX, H.A.

A review of the smoke abatement movement.

In Smoke Abatement Exhibition handbook and guide.  
Manchester. N.S.A.S. 1936. P.5.

147. Report from the Select Committee of the House of Lords on the Smoke nuisance abatement (Metropolis) bill. Reports (H.L.). 1887 (12, 321).

148. Ibid. Paragraph 78.

the point at which it would accept such a bill as this?"

Receiving a negative reply, he continued, "I gather from what you say that you think the public mind is not yet sufficiently educated to enable them to stand with equanimity any interference with their modes of lighting fires, and the construction of their grates . . .".<sup>149</sup> Despite public meetings<sup>149</sup> and newspaper comments in favour of the bill,<sup>150</sup> it did not become law. Public opinion, then and after, was a basic consideration in the British approach to air pollution control.

In 1891, a law, parallelling the Public Health Act of 1875, was passed for the City of London.<sup>151</sup> Prosecution under the new Act was to be instituted by the Vestries, forerunners of the Burgh Councils. They, however, "were apparently quite uninterested and would make no effort to obtain evidence . . .".<sup>152</sup> In response to this official laxity and the concomitant increase in smoke, a small, predominantly upper class, action group was formed in 1899, with the purpose of collecting evidence for the Vestries, and agitating for its use in legal prosecutions. The founding resolution was moved by Sir William Richmond and Lady Frederick Cavendish.<sup>153</sup>

Over the following eight years the Society published their

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149. Ibid. Paragraph 115.

150. Ibid. Paragraph 108.

151. Public health (London) act. 1891.  
Public General Statutes. 54 and 55 Victoria. C.76.

152. Sixty years for clean air - 1899-1959.  
London. National Society for Clean Air. 1959. P.12.

153. Ibid.

comparative research on domestic grates,<sup>154</sup> 155, 156 and a treatise on gas fires.<sup>157</sup> At the same time their own smoke inspector actively reported offences, and was instrumental in obtaining a number of convictions. The Society's organizational activities included a four-day conference and exhibition in 1905, and in 1907 the first course to teach proper methods to stokers. "In order to influence public opinion Dr. J.S. Owens (of the Society) invented the first gauge for collecting and analyzing the dirt which fell from the air in four different districts of London."<sup>158</sup> From this "propaganda exercise", via the Society's International Smoke Abatement Exhibition of 1912 came the Committee for the Investigation of Atmospheric Pollution, which carried out monitoring, following Owen's methods, in most major cities in Britain from 1914 to 1926. From April 1, 1927, the Department of Scientific and Industrial Research took over the Committee's work from the Meteorological Office. The newly titled "Atmospheric Pollution Research Committee" was to provide the Department with expert advice, and, with the help of the "Standing Conference of

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- 154. The Coal Smoke Abatement Society and domestic grates.  
The Lancet. May 10, 1902. P.1333.
  - 155. Tests on certain open domestic grates.  
The Lancet. February 20, 1904. Pp. 529-534.
  - 156. Tests on certain open domestic grates.  
The Lancet. May 19, 1906. P.1413.
  - 157. Gas stoves: an experimental inquiry relating to their thermal efficiency and to hygienic considerations.  
The Lancet. November 17, 1906. P.1361.
  - 158. DES VORUX, H.A. Op. cit. P.6.

Cooperating Bodies", to carry on the monitoring programme.<sup>159</sup>,  
160, 161

The Coal Smoke Abatement Society was not the only body active in this field during the early 1900's. The London Council assisted the Meteorological Council in an investigation of London fogs between 1901 and 1903. The report concluded that twenty percent of fogs were entirely due to smoke, and "that in every case the density and duration of fogs was enormously added to by smoke."<sup>162</sup>

A short time later John Aitken, working at Falkirk, explained the increased incidence of day fog in industrial atmospheres.<sup>163</sup> Ozone and hydrogen peroxide, produced under ultraviolet radiation from the sun, combined with  $\text{SO}_2$ , from coal burning, to form heavy, often hygroscopic, nuclei which developed into fog in the absence of advection and strong convective mixing. This fog type would not be removed by smoke control, because  $\text{SO}_2$  was the operative pollutant. Pioneer research on another aspect of air pollution, damage caused to vegetation,

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- 159. Committee for the Investigation of Atmospheric Pollution - Report.  
The Lancet. February 26, 1916.
  - 160. The Advisory Committee on Atmospheric Pollution - Annual reports 1917 to 1926.  
The Meteorological Office. H.M.S.O.
  - 161. Atmospheric Pollution Research Committee - Annual reports from 1927 to 1958. (Thereafter published by Warren Spring Laboratory.)  
Department of Scientific and Industrial Research. H.M.S.O.
  - 162. Investigation of London fogs, 1901-1903.  
London. Meteorological Council.
  - 163. Aitken, J. 1912.  
The sun as a fog producer.  
Proceedings of the Royal Society of Edinburgh 32 (2), 183-208.



was carried on at this time by Professor Cohen at Leeds. <sup>164</sup>

The national government established yet another study commission to ascertain what laws were in force "in certain foreign countries in regard to the emission of smoke from chimneys." <sup>165</sup>

In general this survey showed that smoke was dealt with as a "nuisance" under civil law, with certain large cities having police acts for additional controls. The most sophisticated attempts at control legislation were reported for Pittsburgh, Philadelphia, Buffalo, and Chicago, in the U.S.A. No national laws, beyond those pertaining to nuisance, were found to exist. Two comments in the report do bear repetition. The Austrian said, "There is a well-known saying to the effect that a good stoker is the best consumer of smoke." The Hungarian noted that, "As regards household fires no regulations are required as stoves are in universal use".

A new smoke control bill, drafted by the Smoke Abatement League in Manchester, had received support at the International Smoke Abatement Exhibition. Mr. A.G.C. Harvey presented it in the House in 1913, <sup>166</sup> but it was not enacted. A further attempt was made by Lord Newton when he prepared a bill in 1914. <sup>167</sup> Under this pressure, the government followed the

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164. COHEN, J.B. 1920.

The effects of air pollution by smoke and its prevention.  
J. Soc. Chem. Ind. 284-285.

165. Reports on the laws in force in certain foreign countries in regard to the emission of smoke from chimneys. 1905 (Cmd. 2347).

166. Smoke abatement act.  
Bills. 1913 (136).

167. A bill to provide for the abatement of smoke.  
Bills. 1914 (136).

now standard procedure of setting up a study commission preparatory to bringing in their own legislation. With this assurance, Lord Newton withdrew his bill.

Following the 1914-18 war, the Committee on Smoke and Noxious Vapours Abatement was reconstituted under the chairmanship of Lord Newton. He moved quickly to bring in an interim report,<sup>168</sup> urging that "smokeless" heating be a precondition for government housing grants, and that every effort be made to lower the price of electricity and gas. Even at this early date he was able to offer estimates of the costs of air pollution per person based on work at Pittsburgh, Pennsylvania,<sup>169</sup> and Manchester.<sup>170</sup> In response to the Committee's work and "in the face of much opposition from industry", a government bill<sup>171</sup> was at last prepared and guided through the House by the then Minister of Health, Mr. Neville Chamberlain.

The Act<sup>172</sup> extended the 1875 definition of "smoke" to include soot, ash, grit, and gritty particles and to specify that any smoke, not necessarily black smoke, could be a nuisance.

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- 168. A bill to provide for the abatement of smoke.  
Bills. 1914 (136).
  - 169. The economic cost of smoke nuisance to Pittsburgh.  
Pittsburgh. University of Pittsburgh Department of  
Industrial Research. 1913.
  - 170. A comparative study of washing costs in comparable work-  
ing class homes in Manchester and Harrogate.  
Manchester Air Pollution Advisory Board. 1918.  
(7½d more per household per week in Manchester.)
  - 171. Public health (smoke abatement) bill.  
Bills. 1926 (110).
  - 172. Public health (smoke abatement) act. 1926.  
Public General Statutes. 16 and 17 George V. C.43.

It stiffened penalties and provided for the Minister of Health to require local authorities to pass byelaws forbidding certain classes of noxious smoke emissions. He also received powers to add to the list of "scheduled" industries under the Alkali Acts. Local authorities were permitted to join together for common byelaws on smoke control or to finance research. Although the "best practicable means" defence still applied, the Act apparently met with some success. Prosecutions were, however, relatively few, because offending industries tended to interpret this law as evidence of public arousal and government determination to bring smoke under control. They usually made alterations voluntarily in response to the inspectors' advice.<sup>173</sup> The Act did not apply to Scotland.

From the turn of the century, the number of smoke abatement societies grew steadily throughout the country. A Scottish branch was established in 1909, and by 1931, thirty-eight such groups existed.<sup>174</sup> The two principal organizations, the Coal Smoke Abatement Society, of London, and the Smoke Abatement League in Manchester, joined forces in 1929 to form the National Smoke Abatement Society.

The new Society retained the action orientation and propagandist traditions of its parent groups. From the earliest days, mass publicity campaigns were ruled out by lack of funds. Therefore, the new Society sought to "devote its resources to educating, informing, and so influencing the opinion of the relatively small

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173. DES VOEUX, H.A. Op. cit. P.6.

174. The smoke abatement handbook.  
Manchester N.S.A.S. 1931. First edition. P.42.

number of those who themselves create or lead public opinion". 175  
 In the first years, publication in The Lancet and provision of  
 information for private members' bills were among their principal  
 methods. In 1929, the new combined Society was able to publish  
 the world's first journal devoted solely to air pollution. 176

London's local authorities expressed optimism regarding progress on smoke control in their responses to a twenty-four item questionnaire administered by the Greater London Joint Smoke Abatement Committee in 1931. 177 There was little optimism in the rest of the thirties: economic depression crippled industry; coal surpluses mounted; unemployment soared. On July 13, 1933, Sir Adrian Baillie spoke in the House of Commons to denounce local authorities who provided housing with no coal-burning grate. The Minister of Mines spoke in his address to the National Smoke Abatement Society Annual Conference in 1936 of "official opposition to any policy involving limitations of the domestic use of coal."

In this situation, it is not surprising that the government

175. MARSH, A.  
 Public opinion and education for clean air in the U.K.  
 London. Proceedings of the International Clean Air Conference. 1959. P.42.
176. Clean air 1 (1), 1929.  
 later:  
 J. National Smoke Abatement Society.  
 later:  
 Smokeless air.
177. Smoke abatement on a regional basis.  
 Manchester. N.S.A.S. 1931. Pp. 25-26.

limited the Public Health Act, 1936,<sup>178</sup> to a restatement and updating of existing law. A similar Act for the City of London was passed in the same year.<sup>179</sup> The only change in Scottish law came in 1939 when burning coal bings were declared nuisances, subject to certain limitations.<sup>180</sup>

During this period the National Smoke Abatement Society propagated the idea of "smokeless zones", and continued to attack the open-grate domestic coal fire as the prime smoke villain. They convened an exhibition of the latest anti-smoke engineering at South Kensington in 1936, and advocated that all new industries be constructed to use smokeless fuel. In the mid-thirties the Owen's air filter, developed by an official of the Society, was incorporated into the national air monitoring scheme.

Although the National Smoke Abatement Society continued to publish their quarterly journal during the war, smoke control had little priority with anyone else. Indeed, smoke production was encouraged on certain occasions to confuse enemy aircraft. The Society developed an improved grate in 1942, and subsequently planned the role of smokeless zones in post-war reconstruction.<sup>181, 182</sup>

- 178. Public health act. 1936.  
Public General Statutes. 26 George V and Edward VIII.  
C.49.
- 179. Public health (London) act. 1936.  
Public General Statutes. 26 George V and 1 Edward VIII. C.50.
- 180. Public health (coal mine and refuse) (Scotland) act. 1939.  
Public General Statutes. 2 and 3 George VI. C.23.
- 181. Plan for clean air.  
Manchester. N.S.A.S. (no date)
- 182. Smoke prevention in relation to initial post-war reconstruction.  
Manchester. N.S.A.S. (no date).

Foster <sup>183</sup> has traced the vicissitudes of the smokeless zone concept from its inception, through support by the Simon Commission, <sup>184</sup> to adoption in major cities under local Acts, beginning with Manchester in 1946. <sup>185</sup> Edinburgh obtained such powers in 1950, <sup>186</sup> but did not use them immediately.

Possibly the best available index of public perception of air pollution at a given time is the frequency of items on the topic in newspapers. Newsmen must assess the current interest in a subject in deciding what to publish in the way of features and editorials. Letters to the editor often identify points of contention. "Hard news" tells what was going on regarding the subject. Although each of these classes of news could be examined profitably, only frequency of items per year is considered here, and that only for The Times. (Figure 5-3) The graph shows a relatively low level of attention to the subject, except during periods when legislation was passed <sup>187</sup> or of activity by the National Smoke Abatement Society. <sup>188</sup> Many of the items are reports of the National Smoke Abatement Society

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183. FOSTER, L.T.  
On the adoption of smoke control areas in the U.K.  
Paper presented to:  
Seminar on Social Dimensions of Air Pollution.  
Edinburgh. January 2-4, 1972.
184. Domestic fuel policy, report by the Fuel and Power Advisory Council. 1946 (Cmd. 6762).
185. Manchester Corporation act. 1946.  
Local Acts. 9 and 10 George VI. C.38.
186. Edinburgh Corporation order confirmation act. 1950.  
Local Acts. 14 George VI. C.27.
187. 1926, 1936.
188. 1898, 1907, 1944, 1945.

annual meetings. The striking feature of the graph is the sharp rise in frequency following the 1952 smog disaster in London.

## CONCLUSIONS

### Pre-industrial air pollution

During this period air pollution had two basic meanings in Great Britain: coal smoke; and stench from sewers and "offensive" industries. After that time, pollution associated with mining, industrial processing, and later, petrochemical works, took on importance.

In the period from 1300 to 1750 coal was in short supply and expensive. It was consumed in industrial furnaces and domestic fireplaces whose poor design was matched by the inadequacies of their chimneys and the inefficiencies of firing techniques. Legal smoke control, when it occurred, was of the "off with their heads" variety employed by Edward I, and moderated in late Tudor and early Stuart times to prohibition of sea-coal burning during the sitting of Parliament. Odours from sewers, burial grounds, and slaughter houses were annoying, but until the germ theory of disease became accepted in the nineteenth century, they were not considered dangerous.

### Impetus to awareness

Following this period a number of factors militated for greater awareness of air pollution as a problem.

The effects of increasing coal supplies, industrialization, and urbanization were compounded by factories being located in cities, or, more accurately, by workers living near their factory



jobs. In short, air pollution was getting worse and affecting more people.

As mass transportation improved in the early 1800's, the better off were able to commute by rail from suburban residences, and by contrast became more critically aware of city pollution. But as with the introduction of the automobile a century later, the new freedom of location brought with it new pollution problems in terms of smoke and exhaust gases.

From the mid-eighteenth century, enclosed stoves provided a more efficient and smokeless means of burning coal, and coke became available. Slightly later the mechanical stoker and air injection furnace made smokeless combustion with ordinary coal a possibility for industry. As individual factories solved their own smoke problems they frequently patented their process and sought to sell it to others. Thus, by 1880 there was a plethora of smoke-consuming methods on the market.

The contribution of research was to link polluted air with respiratory diseases and rickets; mental depression; damage to vegetation; corrosion of metals; deterioration of stonework; and loss of sunlight. Mortality, particularly among infants, was so much higher in London than in the surrounding countryside that the city's population was only sustained by migration from rural areas. As the principles of public health became established, sewer construction, poor ventilation in buildings, and "offensive industries" became recognized as threats to health as well as nuisances. Controls were effected during the nineteenth century.

In the time of Empire the upper classes felt a moral

imperative to better the lot of deprived peoples, including their own working class, whom they felt were so habituated to factory filth as not to realize their debased condition. Cleanliness was next to godliness; godliness was valued. To be clean and to teach others to be clean had a connotation of moral righteousness. This influential group was also concerned because of national pride. What would visitors think of such a dirty capital? For them it was a contradictory position to be exporting civilization to the world from "the Court of Vulcan, Stromboli, or the Suburbs of Hell".<sup>189</sup> These people were the basic strength of the smoke abatement societies that became active toward the end of the nineteenth century.

#### Factors retarding air pollution control

Transportation of coal, even by sea, added markedly to fuel costs. Therefore, industrial cities tended to use the nearest coal supply, even if it were bituminous. London's cheapest supplier was apparently Newcastle, so that the superior South Wales coal had a smaller share of the market. On the national scale, a healthy domestic coal industry was essential to defence. In this argument, too, smoke had little relevance. In the period following 1750 "laissez-faire" economics held sway. This implied a "hands off" policy for domestic industry, particularly in such a vital matter as energy.

The contention that increased costs for pollution control would raise product prices, reduce competitiveness abroad, and force some manufacturers to the wall, was as effective then as now.

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189. EVELYN, J. Op. cit. P.19.

Even when legislation was desired, the framing of law in this area was bedevilled by many difficulties. What was "black smoke" and how did you measure it? What was a "nuisance"? How much did it matter if a few people were bothered? With whom should the burden of proof lie, accused or accuser? Fuel combustion was only one source of air pollution; nuisances from sewers, slaughter houses and piggeries could not be regulated within anti-smoke laws. In individual communities, industrialists frequently held influential positions. On the council, they might be asked to frame and pass smoke control laws. On the bench, an industrialist-magistrate could hear a case accusing his neighbouring factory of smoke pollution. Enforcement procedures could hardly be independent of such pressures.

The piecemeal approach to legislation created a confusion of jurisdictions and enforcement procedures. In addition to the appeal against nuisance under common law, three kinds of statute law existed: Public Health Acts dealt with sewers, ventilation of buildings, and offensive trades; anti-smoke statutes regulated fuel use in factories; Alkali Acts concerned industrial processes. Each of these national laws allowed local acts to deal with the particular needs of certain cities. Each area of regulation had its own means of enforcement. Sanitary inspectors, police, and Alkali Inspectors shared, occasionally overlapping and conflicting responsibility.

In the absence of popular demand for pollution control successive governments were well content to establish repetitive study commissions. When forced, they would introduce strongly worded laws, but with an escape clause involving "best practicable

means", and provision that enforcement was to be considered in the local context and by local courts.

This approach did have two useful outcomes. First, the legislative process became an elaborate communications tool for indicating to industrialists the likely direction and nature of future controls, and so facilitated voluntary compliance with these standards, in some cases. Second, when widespread popular demand for national anti-pollution measures did arise, the many study reports available permitted rapid action.

## Chapter 6

### BACKGROUND TO THE CLEAN AIR ACTS, AND THEIR IMPLEMENTATION IN EDINBURGH

#### THE IMMEDIATE POST-WAR YEARS

The outlook for smoke control was not bright in the early post-war years. Fuel was in short supply and rationed by the Ministry of Fuel and Power; what was available often did not suit the appliances in which it was burned. Appliances themselves were, in many cases, in poor repair due to an absence of spares, both during and just after the war. The Chief Sanitary Inspector for Edinburgh, Mr. Allan Ritchie, commented in his annual report of 1946 that the only factor militating for reduced smoke emission in the city was the Ministry's restriction on supplies of coal.

There were, however, other more positive forces at work. The fuel shortage brought home to government and industry alike the need for efficient fuel combustion. To this end the Ministry of Fuel and Power maintained Regional Fuel Engineers to advise on specific local problems.<sup>1</sup> In Edinburgh, this official worked in co-operation with the Corporation Smoke Abatement Officer to continue winter lectures in efficient boilerhouse practice and to give talks to "interested societies".<sup>2</sup>

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1. Yearbook.  
London. National Smoke Abatement Society. 1952. P.27.
  2. Annual reports of the Chief Sanitary Inspector.  
Edinburgh Corporation. 1945 to 1960.

For industrialists, during this period the social responsibility to reduce smoke coincided happily with their vocational responsibility to increase profits. Both influences encouraged the introduction of mechanical stokers as these became available. Boilermen, for their part, could best protect their jobs by becoming more efficient through attendance at the lectures for stokers. In the period 1930 to 1960 approximately twenty-five men attended these lectures each year, with the exception of war times. Thus, in the short term, more efficient attendants, and in the longer term mechanical stokers, combined to reduce progressively smoke emission from central heating plants and industrial boilers.

During the war years, even while smoke control legislation was suspended and "create smoke directives" were in force for security reasons,<sup>3</sup> the National Smoke Abatement Society was preparing for post-war recovery. William Gandy's "smokeless zone" concept, first put forth in the mid-thirties, was re-enunciated. Other recommendations urged that all new plant be constructed so as to be smokeless, and that a newly designed smokeless grate be incorporated in all new houses. The Society continued its objective to "devote . . . resources to educating, informing, and so influencing the opinion of the relatively small number of those who themselves create and lead public opinion".<sup>4</sup>

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3. Ibid. 1945.

4. MARSH, A.  
Public opinion and education for clean air in the U.K.  
London. Proceedings of the International Clean Air Conference. 1959. Pp. 42-43.

The report by Lord Simon's Fuel and Power Advisory Council regarding domestic fuel policy gave the Society's aims a great boost.<sup>5</sup> It included recommendations that the government encourage production of smokeless fuels and heating appliances for domestic use, and restrict bituminous coal solely to large plants capable of burning it smokelessly. Subsidies were suggested for grate conversions, and for central and community heating facilities. Preferably, these would be linked to experimental smokeless zones. The Society's annual report of 1952 noted with satisfaction that the Council's policy was "largely identical with that needed for the abolition of household smoke".<sup>6</sup>

Efforts to implement the Simon Report's recommendations affected Edinburgh in 1946, when a communication from the Scottish Branch of the Society<sup>7</sup> urged the Corporation to encourage the use of smokeless fuels, and the installation of new domestic grates. The letter also sought agreement in principle with the "smokeless zone" concept and the need for "prior approval" of all building plans, from a smoke control point of view. The last two points were passed on to the Lord Provost's Committee along with a "provisional order" regarding

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5. Domestic fuel policy (Simon report).  
London. Fuel and Power Advisory Council. H.M.S.O. 1946.
  6. Yearbook. National Smoke Abatement Society. Op. cit.  
P.28.
  7. The Scottish Branch of the National Smoke Abatement Society was established at Glasgow in 1909, and its membership broadened to include all Scotland in 1927.



smoke, which had already been under consideration.<sup>8</sup>

Following their 1947 national conference in Edinburgh the Society suggested that the Corporation consider new legislation for controlling industrial smoke.<sup>9</sup> In a further contact, in 1949, the city was urged to send representatives to the next annual meeting. This attention from the Society prompted the Health Committee to request a report from the Chief Sanitary Inspector on the whole question of smoke nuisance and smoke abatement in the city.<sup>10</sup>

Mr. Ritchie, reporting in June 1949,<sup>11</sup> recommended that the Society's suggestion of a ten-year programme to focus concerted effort on eradication of smoke should be adopted for Edinburgh. He rehearsed the adverse effects of air pollution on materials, vegetation, amenity and human health, and assessed the extent of Edinburgh's problem on the basis of 1948 dust-fall data from the Corporation's four monitoring sites. Mr. Ritchie pointed out that Edinburgh's legal powers in this matter rested on the Edinburgh Corporation Order of 1933 which did not provide for the making of bye-laws in the same way that the Public Health Act 1936 did for English local authorities. Thus, implementation of these suggestions before the Health

8. Public Health Committee,  
General Purpose Sub-committee. 18.6.46.

9. Ibid. 7.9.48.

10. Public Health Committee. 24.5.49.

11. RITCHIE, A.  
Representation by the Chief Sanitary Inspector on smoke  
abatement in the city.  
Public Health Committee. Intradepartmental document. 1949.

Committee would require a change in law. Nonetheless, he made the following recommendations:

- a) The new type fireplaces should be mandatory in all new houses and as replacement for existing defective grates;
- b) Smokeless fuel, including coke, should be used in domestic fireplaces, central heating plants, and smaller type industrial units;
- c) District heating schemes should be adopted in suitable new housing areas;
- d) Use of gas or electrical appliances should be encouraged;
- e) Mechanical stokers should be installed to fire larger boilers;
- f) Use of anthracite and semi-anthracite should be encouraged;
- g) All Corporation undertakings should adopt smokeless methods;
- h) Smokeless zones should be established; first in the central area - Princes Street, George Street, Queen Street, and vicinity and gradually be extended outwards;
- i) An official approach should be made to British Railways about smoke pollution at all the main stations and particularly in Princes Street Gardens, as well as the nuisance being created by their locomotive sheds.

Mr. Ritchie's concluding remarks merit quotation because they summarize the basic official attitude to smoke control in Edinburgh:

"Although legislation can be an effective means in securing smoke abatement, the major part in improvement has been, and can be achieved, by education, persuasion and co-operation. It is therefore of the utmost importance to gain the full support of those engaged in industry and commerce as well as owners and occupiers of houses and buildings in an intensive campaign to make the air of Edinburgh clean. With this view, it might be possible to have meetings with the Chamber of Commerce and industrial, commercial and other groups."

Following this report the Health Committee resolved to approach the Chamber of Commerce, and other potentially interested groups, in order to obtain their co-operation in a smoke control programme.<sup>12</sup> Also, the Lord Provost's Committee undertook to consider the inclusion of smoke abatement powers in the next Provisional Order. In September of 1950, this came to fruition when the Smokeless Zone Sector of the Edinburgh Corporation Order was approved by the Town Council, with powers given to the Health Committee.<sup>13</sup>

Following a letter from the National Smoke Abatement Society urging, once again, the use of smokeless fuels and new grates, the Chief Sanitary Inspector, Mr. Anderson, recommended that women sanitary inspectors, when advising housewives, should recommend the use of smokeless fuels, whenever this was economically possible.<sup>14</sup>

In the next few years, little use was made of the new powers under Edinburgh Corporation Order, because "... the scarcity of smokeless fuels ... considerably hampered

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12. Public Health Committee. 20.9.49.

13. Town Council. 28.9.50.

14. Public Health Committee. 17.1.50.

progress".<sup>15</sup> The period was not without public discontent, however. Councillor Brechin requested, in 1953, that the General Health Services Sub-committee consider the problem of industrial pollution in the Slateford and Longstone area, where eighty-one people had signed a protest petition.<sup>16</sup> The industries involved were, apparently, willing to co-operate, but supplies of suitable fuel were not available.

During this lull in Edinburgh's smoke control activity the first smokeless zone was established in Coventry, and became effective March 1, 1951, followed by Manchester on May 1, 1952.

Salford's attempt to establish three smokeless zones was rejected by Ministry of Health and Local Government because the existing steel shortage would make conversions difficult, and supply of smokeless fuel could not be ensured. This was in spite of the assurance of local suppliers that they could cope with the anticipated demand, and the fact that coke had been taken off ration in 1949. The National Smoke Abatement Society pointed out that only a small quantity of steel would be required, as it was mainly a fuel change that was needed.<sup>17</sup> This decision suggested that in spite of the recommendations of the Simon<sup>18</sup> and Ridley<sup>19</sup> Committees, smoke abatement was not a

15. The Scotsman. 21.4.54.

16. Public Health Committee,  
General Health Services Sub-committee. 7.7.53.

17. Yearbook.  
London. National Smoke Abatement Society. 1953. P.6.

18. Domestic fuel policy (Simon report). Op. cit.

19. National policy for the use of fuel and power resources.  
Reports. 1951-52 (Cmd. 8647).

high government priority at the time, at least insofar as domestic sources were concerned.

#### THE INFLUENCE OF THE LONDON SMOG

Between December 5 and 9, 1952, 4,000 people died because of polluted air in Greater London.<sup>20</sup> After a period of initial quiescence, public opinion was gradually aroused as accounts of the extent of the disaster slowly gained currency over the following few months. Reports then being published on studies of the much less severe Donora, Pennsylvania, episode, were urged by the National Smoke Abatement Society as a model for similar investigations of the London tragedy.

The London experience was being interpreted with national significance.<sup>21</sup> The frequency of news coverage on the subject increased markedly. (Figure 5-3) Some of the questions occupying press attention in the summer and autumn of 1953 were:<sup>22</sup>

- a) If polluted air could cause death in one large city, why not in another?
- b) What were the factors contributing to such an acute episode?
- c) How likely was such an occurrence in other cities, or a recurrence in London?
- d) How much use were smog masks?

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20. LOGAN, W.P.D. 1953.  
The Lancet. February 14, 1953.

21. Yearbook.  
London. National Smoke Abatement Society. 1954. P.7.

22. Ibid.

At very least the Great Smog had served to identify air pollution in the public mind as a potentially lethal threat to immediate personal health. This concern, approaching anxiety, made some government action necessary, if for no other reason than to quiet public fears.

#### The Beaver Committee

The action, when it came on July 21, 1952, took the familiar form of another study commission. The work of Lord Beaver's Committee was facilitated by the wealth of information collected and sifted by its many predecessors. An interim report <sup>23</sup> was quickly prepared, followed within eleven months by a final report. <sup>24</sup> Little of it was new. The Committee pointed to the association of air pollution with the occurrence of bronchitis, pneumonia and, possibly, with certain forms of cancer. In addition to physical effects, they felt that there might well be serious psychological consequences of reduced light and sunshine in polluted cities. The final report estimated the quantifiable costs of air pollution in the United Kingdom, including damage to property, at £5 per person per year. <sup>25</sup>

As to the future, the Committee recommended that all industries with particular technical impediments to smoke control should be assigned to the Alkali Inspectorate, and that all

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23. Committee on Air Pollution (Beaver Committee).  
Interim report.  
London. H.M.S.O. December, 1953.

24. Committee on Air Pollution (Beaver Committee).  
Final report.  
London. H.M.S.O. November, 1954.

25. The M.O.H.'s annual report to Edinburgh Corporation for 1934 estimates the total annual cost of smoke pollution in the city at £567,000.

factories be prohibited from making more than six minutes of "dark" smoke <sup>26</sup> in four hours, and no more than three minutes continuous at any time. Government should give loan aid to industries for capital expenditure associated with controlling emissions, and provide training for their employees in boiler-room management. Similar regulations should be imposed on railways until diesel electric engines could come into service. Correct maintenance and operation were suggested as the best means to control vehicle emissions.

In addition to smokeless zones, the Committee advocated "smoke control areas", wherein only smokeless fuel would be used for domestic heating. This could be accomplished in local authority housing schemes by making the use of such fuel a condition of tenancy. The cost of proposed conversions should be borne half by the Exchequer, and the remainder shared by the householder and local authority. Reduction in purchase tax on gas and electric heating apparatus would be an additional incentive.

#### Local authority response - Edinburgh

The ideas of Lord Beaver's report were by no means new to local governments. In Edinburgh, for example, when a summary of the recommendations was presented to the Corporation's Health Committee by the M.O.H. <sup>27</sup> the ground had already been well prepared by correspondence from the National Smoke Abatement Society,

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26. Ringelmann scale. No.2.

27. SEILER, H.E., M.O.H.  
Public Health Committee. Intradepartmental document.  
December, 1954.



from Sir Patrick Nollan of the Scottish Fuel Efficiency Committee, and by a visit to the city by members of the Beaver Committee itself.

Sir Patrick had pointed out the success of Manchester's smokeless zone, and of Nottingham's tenancy agreement, in achieving the sole use of smokeless fuel in domestic areas. He had enquired whether Edinburgh had plans to follow these excellent examples. In reply, he was told that a preliminary report regarding smokeless zones was in preparation, but that the local fuel overseer had reported to the Health Committee that smokeless fuel was not sufficiently available in Scotland to assure supply. Although smokeless fuels could be brought in from England, prices were, in the overseer's view, prohibitive for domestic use.<sup>28</sup>

When representatives of the Beaver Committee and the Corporation had met, in April of 1954, the Committee members recommended that some legislative provision regarding air pollution be undertaken, preferably in a coordinated way with surrounding local authorities.<sup>29</sup> While accepting the need for legislation, the Corporation representatives rejected the idea of cooperation with surrounding jurisdictions which had not yet obtained the special powers necessary to deal with the problem,<sup>30</sup> as had

28. Public Health Committee. 8.9.53 and 13.10.53.

29. This could be interpreted as a forerunner to "air shed" pollution control, which was to be in vogue in the U.S. twenty-five years later.

30. Public Health Committee.  
General Health Services Sub-committee. 22.4.54.

Edinburgh. <sup>31</sup>

In the same month, a status report on smokeless zones in the city had been presented by the M.O.H. and the Chief Sanitary Inspector. <sup>32</sup> They pointed out that the establishment of such areas had been hampered by the scarcity and expense of smokeless fuels. Recently, however, there had been official assurances that supplies of coke, the cheapest form of smokeless fuel, were adequate. The Central City smokeless zone, suggested in the Chief Sanitary Inspector's annual report of 1949, had therefore been the subject of a preliminary survey which showed that there were about eight hundred substandard houses in the proposed area, between Princes Street and Queen Street. It was concluded that these houses would be expensive to convert and the advantage gained in smoke abatement would quite likely be lost in the emissions from the nearby railway. The report suggested that a smokeless zone on the west of the city would be more desirable, because it could take advantage of prevailing west-to-east weather, and, in that part of the city, there were many Corporation houses with modern grates which could be readily adapted to burn smokeless fuel. There was, however, no requirement that private builders provide such grates. The Health Committee resolved to recommend approval in principle of smokeless zones, and that the M.O.H. should investigate possible areas, other than the central city,

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31. Edinburgh Corporation order confirmation act, 1950.  
Part III, Section 24.  
Local Acts. 14 George VI. C.27.

32. Public Health Committee.  
General Health Services Sub-committee. 6.4.54.

for this purpose. They also wished to have further consideration of the possibility of tenancy agreements to ensure use of smokeless fuel in certain Corporation housing schemes, and consideration of possible methods of requiring that all builders install only approved fireplaces.

The process of consultation with local authorities employed by Beaver, together with the educational work of the National Smoke Abatement Society and other interested bodies, had thus laid the ground-work which made it possible to capitalize on the improved economic possibilities for smoke control in the early fifties, and on the widespread concern generated by London's smog. Through these efforts and the enthusiasm of a few local officials, some of the Beaver recommendations were well on the way to implementation before any new legal machinery came into effect. For example, in Edinburgh, the Housing Committee proposed the provision of gas jets for the new Corporation houses at Gracemount. This would allow a tenancy agreement requiring use of smokeless fuel to be effected by the provision of gas poker, if fuel supplies proved adequate when the project was nearer to completion.<sup>33</sup>

Smoke control was also advancing on another front. In their report on alternative sites for smokeless zones, the M.O.H. and Chief Sanitary Inspector pointed out that Edinburgh's main smoke problem arose from domestic coal fires, as there were no essentially industrial areas in the city.<sup>34</sup> The two main

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33. Ibid. 16.11.54.

34. Ibid. 22.3.55.

industries, printing and brewing were distributed over a wide area. They suggested that the proposed Sighthill Industrial Estate, as the city's only block of industrial emission, be the first smokeless zone, with adjacent areas added in later years.

The Health Committee decided to submit a draft of the Edinburgh Smokeless Zone Order (No. 1), 1955 to the Town Council, where it was adopted on December 1, 1955.<sup>35</sup> The proposed operative date, January 1, 1957, was put back by two months by the Secretary of State for Scotland while he awaited a report on smokeless fuel supplies. (Appendix 7) When it came into effect, Sighthill Number 1 was the first smokeless zone in Scotland.<sup>36</sup>

#### THE CLEAN AIR ACT OF 1956

In the case of smoke control, the new legislation, proposed by Beaver, was enacted faster than the government of the day would have wished. Gerald Nabarro, with the active support of the National Smoke Abatement Society, undertook to present a Private Member's Bill.<sup>37</sup> Faced with this pressure, the government promised to introduce, without delay, its own legislation if Nabarro would withdraw. This he did, and the Clean Air Act<sup>38</sup> received Royal Assent July 5, 1956, to come into operation in stages from December 31, 1956 to December 31, 1958.

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35. Public Health Committee. 22.11.55.

36. Edinburgh Evening News. 17.7.57.

37. Clean air bill.  
Bills. 1964-65 (10).

38. Clean air act. 1956.  
Public General Statutes. 4 Elizabeth II. C.52.

Its major provision was the prohibition of dark smoke, except in special cases, which were set out in the Act.<sup>39</sup> It also required prior approval by the local authority for furnace installations,<sup>40</sup> and permitted the Secretary of State to require smoke density meters to be fitted on chimneys.<sup>41</sup> Local Authorities were given power to declare smokeless zones, and were offered Exchequer grants to offset the costs involved.<sup>42</sup> For the purposes of smoke control, railway engines were to be treated as chimneys.<sup>43</sup>

Periods of grace were permitted on certain provisions to allow the necessary conversions to be completed. The maximum of these was seven years, with local authority permission to be renewed in each of these years. The Secretary of State for Scotland provided local authorities with sample byelaws to aid in implementation of the Clean Air Act, and on December 31, 1956, he published a list of authorized fuels for use in smoke control areas.<sup>44</sup> Initiative for the establishment of such

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39. Ibid. Section 1(1) prohibited smoke darker than number two on the Ringelmann scale.

40. Ibid. Section 3(1-5).

41. Ibid. Section 4(1-2).

42. Ibid. Sections 11 to 15 set the proportion of conversion costs as follows:

Central government	4/10;
Local authority	3/10;
Owner	3/10.

43. Ibid. Section 19.

44. Anthracite, briquetted fuels carbonized in the process of manufacture, coke, electricity, gas, low temperature carbonization fuels, and low volume steam coals.

areas remained with the local authority.

A Clean Air Council for Scotland was set up on November 21, 1957, in accordance with Section 23 of the Clean Air Act. It consisted of a chairman and eighteen other members, appointed by the Secretary of State for Scotland after consultation with local authorities, industries affected by the Act, industries producing fuel, and industries producing appliances. The Council was to assist the Secretary of State in assessing air pollution abatement progress and to obtain expert opinion on the best ways of preventing pollution. It also functioned as an institutionalized opinion sampling tool. Any new proposal could receive quick reaction from the significantly affected groups through their representatives.

How did local authorities react to this "permissive" legislation? The great variation in their response is currently being investigated by Foster,<sup>45</sup> and is beyond the scope and intention of this review. It may, however, illustrate something of the factors and factions involved to look at Edinburgh's experience in effecting this phase of smoke control.

#### MODERN SMOKE CONTROL IN EDINBURGH

In 1957, the modern phase of Edinburgh's control programme became operational with the first smokeless zone at Sighthill (Appendix 7), and the Gracemount experiment in "missive of let" prohibition of non-smokeless fuels. The former was largely

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45. FOSTER, L.T. 1971.

On the adoption of smoke control areas in the U.K. Paper presented to the Seminar on the Social Dimensions of Air Pollution. Edinburgh. January 2-4, 1972.

forward-looking in the sense that it sought to ensure that future industrial development in the area would be smokeless. The latter aroused a certain amount of apprehension because it involved the use of coke in domestic grates. The Health Committee decided to carry out a sample survey to ascertain whether these fears had any foundation.

In a thirty percent sample, sixty-three Gracemount tenants were interviewed, after a minimum three months' occupancy. Eighty-three percent were "satisfied" with their coke fire and gas poker lighting, while only six percent were dissatisfied. Causes of dissatisfaction were "sentimental regard for traditional coal fire", expense, sparking, fumes, and difficulty in lighting. The eleven households in which illness had occurred since the move to Gracemount were investigated, but there was no apparent connection between the kinds of illnesses experienced and the use of coke fires. It was concluded that a large majority of users were well satisfied with coke, particularly with its ability to provide a plentiful supply of hot water. <sup>46</sup>

With the new grants available under the Clean Air Act consideration of a "central smokeless zone" was revived, and a suggestion made for a smoke control area to adjoin the existing Sighthill zone. The former idea was rejected, after a pilot survey by the Chief Sanitary Inspector, who reported that "technical difficulties", involving the storage of the more bulky solid smokeless fuel, would be encountered in tenements. <sup>47</sup>

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46. Public Health Committee,  
General Health Services Sub-committee. 16.4.57.

47. Ibid. 21.10.58.



The proposed Sighthill smoke control area was approved by the Health Committee, with an estimated cost of £7,195.<sup>48</sup> This was to become "Sighthill No. 1". (Table 6-1)

In his annual report of 1958, the Chief Sanitary Inspector, Mr. James Robertson, indicated two major impediments to the implementation of the Act. The first was the uncertain supply of smokeless fuels because of increased demand as more local authorities created smoke control areas. The second concerned the lack of "... support of the general public together with an understanding on their part of the problems involved". He made no recommendation as to how the public might become better informed. However, the elaborate procedure involved in setting up a smoke control area did require at least tacit approval of the citizens. (Figure 6-1)

On the matter of smokeless fuels, the local authority were charged with checking on local supplies, but the ultimate decision in the matter rested with the Secretary of State for Scotland. The minimum six months delay between his final confirmation and the effective date was, in most cases in Edinburgh, extended to allow ample time for conversions, and to avoid the necessity of conversions taking place during the winter months.<sup>49</sup>

The problem of agreeing a long-term smoke-control plan for the city was brought to a head by the M.O.H. He pointed out to

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48. Public Health Committee. 18.6.57.

49. Public Health Committee,  
General Health Services Sub-committee. 14.4.59.

the Health Committee that a severe strain was placed on his department's manpower by the preparation of pilot surveys, which were the basis of provisional proposals to the Secretary of State for Scotland and the detailed survey, which involved a visit to all premises and the examination of every fireplace. If a ten-year target for completion of smoke control over the whole city was to be achieved more personnel were required.<sup>50</sup> Councillor Kane and Lady Morton moved, before the full Health Committee, that additional staff be appointed on the basis of a ten-year plan.<sup>51</sup> (Table 6-2) It was, however, the suggestion of Treasurer Weatherstone and Councillor Gibson for a fifteen-year plan that was finally accepted.<sup>52</sup>

The new plan involved three sequential five-year phases, working from the west and gradually encircling the central core area, which would constitute the final stage. This approach had three principal advantages. In the first place, although the most severe air pollution episodes were known to occur with easterly air flow, the prevailing winds were from the west. The plan would thus allow the benefits of smoke control to be shared, to the greatest possible extent, over the whole city.

Secondly, the proportion of the city's area under smoke control would be impressive from the start, because of the relatively low housing density in that sector. This was

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50. Ibid. 7.7.59.

51. Public Health Committee. 14.7.59.

52. Public Health Committee,  
General Health Services Sub-committee. 26.1.60.

desirable because it demonstrated that the Corporation took smoke control seriously. At the same time, it was a tangible intimation to everyone concerned that smoke control was coming to Edinburgh, in no small way, and that this fact must be considered in any new undertaking, from an individual heating conversion to a housing scheme.

In the third place, the most expensive conversions would be in the old high-density areas of the central city. These were, in many areas, already being converted voluntarily to some form of piped fuel, either for convenience, or because it was becoming more difficult to get coal delivered upstairs. Also, some of these areas were to be demolished for new buildings, which would, of course, be smokeless. Thus, by "hurrying slowly", the Corporation maximized the advantages to be gained from existing trends to convenience fuels, and from their private knowledge of the city's building programme.

The plan also was flexible; it was quickly amended to create two small smoke control areas in the central city.<sup>53</sup> (Table 6-1) These two areas (Map 6-1) were almost smokeless anyway because the large stores and office blocks tended to use mechanical stokers for their central heating systems, and the offices in converted houses tended to prefer gas or electricity for convenience.

The Corporation's plan for smoke control was basically long-term. Although initial gains within smoke control areas occurred, the net improvement for the city as a whole was small

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53. Ibid. 1.3.60.

since the areas initially controlled were of relatively low-emission density. Among the areas to be controlled later, Dalry, Bellevue, Leith, Granton, Pilton, were the dirtier parts of the city. The last three of these, being in a low-lying area, received air drainage under stable conditions from other parts of the city. This exacerbated the effects of an already heavy local emission. The Corporation's plan did nothing to alleviate this situation in the short term, except to allow other factors, such as urban renewal and the trend to convenience fuel, to make their impact.

In terms of politics, smoke control in Edinburgh was supported by Labour and opposed by Progressives and Conservatives, with, of course, notable exceptions, such as Councillors More-Nisbett and Mrs. Ross. (Table 6-2) Labour considered smoke control as health legislation, while the Progressives saw it only in terms of amenity.<sup>54</sup> The principal protagonists were Councillor Nealon for Labour and Councillor Robertson Murray for the Progressives.<sup>55</sup>

Councillor Robertson Murray expressed some of the current doubts about the programme in a series of questions to the Chairman of the Public Health Committee.<sup>56</sup> (Appendix 8) Mrs. Robertson Murray's somewhat hostile attitude was paralleled by that of the coal retailers. In a presentation to the General Health Services Sub-committee these merchants stressed their

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54. Notes on discussion between Les Foster and Councillor Nealon. 6.12.72.

55. Ibid.

56. Public Health Committee. 13.12.60.

anxiety about the uncertain supply of solid smokeless fuel, and intimated that the National Coal Board were working on a new processed fuel, "Bronowski Bullets", which would burn smokelessly in unconverted grates, and would be widely available in 1965, or sooner. <sup>57</sup>

The case of the Coal Merchant's Association was the basis for a motion by Councillor Kyles which suggested that progress in smoke control should be retarded until "adequate quantities of grade one smokeless fuels are available", and that "full consideration" be given to the "N.C.B. fuel which eliminated fireplace conversions". <sup>58</sup> The Health Committee rejected a motion by Labour Councillors Mrs. Smith and Mrs. Nealon that no change be made in the smoke control programme, and accepted an amendment supported by Progressive Councillors Mrs. Ross, More-Nisbett, and Kyles that the matter be resubmitted to sub-committee for a further report by the M.O.H. and the Chief Sanitary Inspector. <sup>59</sup>

This report (Appendix 9) concluded that supplies of solid smokeless fuel had been adequate in the past, and could be assured for the future by summer stock-piling of premium fuels, such as coalite. The N.C.B. had reported that their new solid smokeless fuel was not yet approved commercially, but would certainly be more expensive than "Gloco". A total output of one million tons of the new fuel was anticipated by 1965; of

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57. Public Health Committee,  
General Health Services Sub-committee. 4.7.61.

58. Public Health Committee. 23.5.61.

59. Ibid. 11.5.61.

this Edinburgh might expect to receive 10,000 tons. The report pointed out that this constituted a small proportion of existing consumption of solid fuel, estimated at 355,000 tons per year. The N.C.B. had indicated no plans for a Scottish plant, unless a strong local demand arose, and even then such a plant could not be in operation until 1965 or 1966, at the earliest.

Councillor Kyle's motion to retard the smoke control programme was lost in the Health Committee on a counter motion by Councillors More-Nisbett and Lady Morton.<sup>60</sup> The counter motion, that the smoke control programme proceed without waiting for better supplies of solid smokeless fuels, was then itself defeated in the Town Council.<sup>61</sup> At this stage the Department of Health for Scotland intervened with a letter<sup>62</sup> asking the Edinburgh Corporation not to stop their smoke control project. Although this episode did not delay smoke control, it did show the precariously narrow margin of support that the programme had in the Council.

Over the next ten years, smoke control in Edinburgh made steady progress (Table 6-1, Map 6-1) in spite of six interruptions occasioned by public enquiries. These necessitated diversions of man power to prepare background information for the hearings. The Public Health Department's record of the first of these, City Centre No. 2, is reproduced in its entirety as an example

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60. Ibid. 21.11.61.

61. Town Council. 7.12.61.

62. Dated: 3.1.62.

of the form and general content involved. (Appendix 10)

The principal objections raised during the public enquiries were as follows:

- (a) The supply of solid smokeless fuels would be inadequate because, as the Gas Board change to oil, their production of coke and "Gloco" at Granton would decline sharply. At the same time, other local authorities would be creating smoke control areas and the demand for such fuel would be increasing. If the smoke control programme could be delayed by three to five years the N.C.B. would be able to supply sufficient solid smokeless fuel;
- (b) The cost of heating in a smoke control area would be higher. This objection had two parts: conversions would be costly; and solid smokeless fuel would be more expensive than coal;
- (c) The use of smokeless fuels in domestic grates would constitute a threat to health;
- (d) Smokeless fires, even with solid smokeless fuel, would be less "cheery and companionable" than traditional coal fires;
- (e) Other sources of air pollution occasion more nuisance than domestic fires, for example, government buildings, traffic exhaust, and burning of garden rubbish. These should be regulated first;
- (f) A "clean" area, such as Corstorphine, did not need smoke control;
- (g) Solid smokeless fuel would be poor value for money if



it had been soaked with water by unscrupulous merchants to increase the weight.

These objections were answered by Corporation officials and visiting experts in the following manner:

- (a) The supply of smokeless fuel was the responsibility of the Secretary of State for Scotland. He based his assessment on information which his advisors obtained from manufacturers of solid smokeless fuel and from the Ministry of Power. The supply position included gas and electricity and was not restricted to solid smokeless fuel only;
- (b) The cost of conversions in smoke control areas was covered by a seven-tenths grant, except in cases of hardship, when the Clean Air Act permitted total conversion costs to be paid from public funds. Initially, this concession was paid by the local government, but later, to encourage "laggard" local authorities, by the Exchequer. The Chief Sanitary Inspector, Mr. Dunbar, testified at Central City No. 2 enquiry that, "There is no real additional cost in the production of a B.Th.U. of heat using smokeless fuel than using ordinary coal";
- (c) Dr. Seiler, the M.O.H., testified at the same hearing that the threat to human health with smokeless fuels was no greater than with coal;
- (d) The benefits in terms of reduced damage to materials, cleaning costs, and improved health were considered to more than offset any loss of amenity occasioned by

use of smokeless fuels;

- (e) It was agreed that every effort should be made to limit emissions from government buildings. In the two specific cases mentioned, Saughton Prison and the office blocks at Stenhouse, it was reported that oil-fired furnaces had been installed recently. Traffic exhaust and garden rubbish burning were not dealt with under the Clean Air Act, but could be treated as public nuisances. Industry was regulated under a separate section of the Clean Air Act, and was not involved in the programme to establish smoke control areas;
- (f) "Clean" areas of the city, such as Corstorphine and Sighthill were brought under smoke control because of their geographical position which was usually up-wind of the rest of the city. Therefore, improvement in smoke in these areas would be passed over other sections;
- (g) The matter of moisture content in solid smokeless fuel was raised by Councillor Mrs. Robertson Murray as a result of a survey in the Midlands by the Consumers' Advisory Service.<sup>63</sup> In the survey moisture contents greatly in excess of the British Standard of nine percent for coke at point of manufacture were found. The M.O.H. and the Chief Sanitary Inspector

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63. Public Health Committee,  
General Health Services Sub-committee. 15.10.62.

reported on this matter.<sup>64</sup> They pointed out that excess moisture could be prevented by covering solid fuel during transit and storage. Alternatively, the retail price could be varied according to moisture content. Both possibilities were prohibitively expensive. Their best recommendation was that purchases be made from a reputable dealer. In cases of deliberate watering, the Inspector of Weights and Measures had powers to act under Section 15 of the local byelaws regarding the sale of coal. Although the problem was more extreme in the case of the more porous solid smokeless fuels, it nonetheless applied also to coal.

(Appendix 11)

In the three earliest public enquiries<sup>65</sup> the campaign against smoke control was spearheaded by Mr. Alexander Thomson. Although Mr. Thomson was not a resident of the areas, he personally canvassed approximately 800 signatures of residents in opposition to each of these proposed smoke control areas. He also carried on an extensive correspondence with public health officials, and occasionally with the Secretary of State for Scotland. (Appendix 10) Those initial hearings set the stage, as it were, and brought forward most of the arguments against smoke control. The principal trial of strength, however, came in Corstorphine No. 2 when claims of fuel shortages had greater credibility in view of reductions in gas pressure and electrical

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64. Ibid. 13.11.62.

65. Central City No. 2; Sighthill No. 3; Corstorphine No. 1.

voltage, and the failure of solid smokeless fuel supplies, during the extreme winter of 1962-63. Although Mr. Thomson was present at this Corstorphine enquiry, the role of principal objector was assumed by Councillor Mrs. Robertson Murray. Corstorphine No. 2 had easily the best prepared opposition case of any of the enquiries, and indeed, the reporter did suggest that the Secretary of State consider delaying the control zone. The delay, when it came, was months rather than years as the objectors had wished. The Corstorphine 4 hearing was merely a formality.

Murrayfield/Cramond No. 1 revived opposition briefly, although there was only one objector, Mr. J.D. Gordon. He believed, on the basis of personal experience, that the use of smokeless fuel, under conditions of cold still weather, could constitute a threat to the health of occupants. His daughter had very nearly been asphyxiated in a first floor room by fumes from a ground floor heater. A fuel technologist from the Coal Utilization Council, Mr. L.F. Jacobsen, testified that the problem most likely arose because the chimney was unlined at the time of the accident. The problem had not been repeated since flues were inserted into the chimney. Mr. Gordon's objection to the smoke control order was turned down.

The Edinburgh experience seems to indicate that popular public opposition to smoke control was never very great. When someone, like Mr. Thomson, was willing to make an effort, he could get signatures, but not specific complaints. The main opposition stemmed from the coal merchants who saw that smoke control meant a forced choice for householders among solid

smokeless fuel, gas, and electricity, at a time when supplies of solid smokeless fuel were demonstrably uncertain. Smoke control threatened to accelerate the existing trend to gas and electricity and hence to undermine the already declining livelihood of coal retailers.

The coal merchants were not without allies. The Solid Smokeless Fuels Federation provided a mobile exhibition unit for use in Sighthill No. 4,<sup>66</sup> so residents could see the options offered by their products. The Progressive Councillors Mrs. Robertson Murray and Kyles were sympathetic to the coal merchants' cause and took every possible measure to gain time in which solid smokeless fuel could obtain a better competitive position.

Although each of the public enquiries delayed implementation of that particular smoke control area, and to a lesser extent, the whole smoke control programme, none was successful in blocking any proposed control zone. The smoke control programme continued until 1968 with only minor controversy over methods of igniting solid smokeless fuel,<sup>67</sup> and regarding operational dates of new smoke control areas.<sup>68</sup>

Early in 1968, a cutback in local government expenditure was caused by the national economic situation. The M.O.H. reported that a saving of £20,000 could be made in estimated expenditure for 1968-69 financial year by slowing smoke control programme, and thus saving on conversion grants and salaries.

66. 21st to 26th May, 1962.

67. E.g. Public Health Committee,  
General Health Services Sub-committee. 30.3.65.

68. Ibid. 11.10.66.

The Progressive Councillors Donaldson and Hedderwick supported this slow-down; Labour Councillors Mrs. Nealon and Hand opposed. The retardation of smoke control in the interests of restricting expenditure was approved in the Health Committee by seven votes to six.<sup>69</sup> Edinburgh Evening News reported that the choice facing the Committee was between maintenance of the smoke control programme and the provision of day nurseries.<sup>70</sup> A modified programme was initiated, within the new financial constraints, but even this was curtailed by shortages of solid smokeless fuel.<sup>71</sup>

As the economic situation improved, the Secretary of State for Scotland decided that an increased programme of expenditure on public works could be financed during 1971-72 and 1972-73. Projects undertaken would have to be completed by March, 1973.<sup>72</sup> In response, the M.O.H. obtained Health Committee approval for three additional control zones in Colinton No. 2, Pilton No. 3, and Craigmillar No. 1.<sup>73</sup> (Map 6-1)

#### AIR MONITORING

##### Edinburgh

From 1914, smoke control operations in Edinburgh were paralleled by an air monitoring programme carried out in co-

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69. Public Health Committee. 16.4.68.

70. Edinburgh Evening News. 28.4.67.

71. Public Health Committee,  
General Health Services Sub-committee. 3.2.70.

72. Circular 58/71.

73. Public Health Committee. 20.7.71.

operation with the Committee for the Investigation of Atmospheric Pollution (Table 6-3). In that year a deposit gauge was sited at Leith Links.<sup>74</sup> This was of a standard type, four feet in overall height, with a ten-inch, latticed baffle ringing a one-foot diameter funnel. The funnel was linked to an earthenware (later glass) jug of about two gallons capacity by a rubber tube through a two-holed stopper. The bottle's contents were analyzed monthly for pH value,  $\text{Ca}^{++}$ ,  $\text{Cl}^-$ ,  $\text{SO}_4^{=}$ , total dissolved material, and ash. Interpretation of the data was difficult, because the results fluctuated according to weather, increasing directly with the number of rainy days.<sup>75</sup>

The first recorded sampling of ambient air at Edinburgh was during the period 1935 to 1939 when an "Owen's air filter" was operated at the Public Health Chambers:

"... by its means, a record is made every twenty minutes, by aspirating a two-litre sample of air through a disc of filter paper; the suspended impurity is retained on the surface of the paper as a small greyish circle, one-eighth of an inch in diameter, the density of which is compared with a standard scale."<sup>76</sup>

These data suggested a diurnal variation in suspended particulates involving peaks coinciding with breakfast and supper hours and minimum levels from midnight to three in the morning.<sup>77</sup> The Owen's filter was not operated after 1939.

From March 1935, lead peroxide candles were exposed at Charlotte Square, and for some months at two locations at the

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74. At this time Leith was not part of Edinburgh.

75. Annual report of the M.O.H. 1930.

76. Ibid. 1935.

77. Ibid.



National Gallery. The "candle" consisted of:

"a small piece of fabric, which is coated with a chemical paste, being exposed to the atmosphere, the paste absorbing a very small proportion of the sulphur impurities. The paste is removed and analysed at the beginning of each month and a fresh surface exposed." 78

Results were calculated in terms of sulphuric acid deposition per day. Wilsdon described the methodology for calculating sulphur pollution from the amount of lead sulphate present on the fabric after exposure. He noted the many shortcomings of the candles, including the influence of wind speed, and temperature on the rate of absorption. Their main value was as indicators of the "activity of sulphur" in the air as a corrosive agent. 79

In January 1958, the Edinburgh Health Department sought to confirm the value of smoke control areas by operating a continuous, 24-hour smoke and SO<sub>2</sub> sampler in Sighthill No. 1. The machine operated for one year before the smoke control area came into operation and for two years after. On this basis, it was concluded that there had been "a definite reduction in air pollution in each of the years following the introduction of smoke control." 80

Six sites were operated for the Survey by the Edinburgh Public Health Department in 1962. In 1964, two from these were retained and a further seven set up. During 1963 and 1964, the

78. Ibid.

79. WILSDON, B.H.  
Appendix 1.  
Twentieth annual report of the Atmospheric Pollution Research Committee.  
London. D.S.I.R. H.M.S.O. 1934.

80. Precognition of Henry Edmund Seiler, M.O.H.  
Public Health Department. Intradepartmental report. No date.  
P.2.

University Geography Department used similar machines, under a grant from D.S.I.R., in order to complement Public Health Department data, and to allow a more accurate assessment of the distribution of smoke and  $\text{SO}_2$  over the city in differing weather conditions.<sup>81</sup> Subsequently, the Geography Department sampling operation was extended to investigate the effect of landforms and specific buildings on pollution concentrations.<sup>82</sup>

On the basis of the National Survey data an approximate comparison of pollution intensities in various U.K. cities can be made. (Figure 6-2) For the period involved, Edinburgh shows a relatively heavy loading of particulate matter, but rather less sulphur dioxide than the other cities.

#### National coordination of air monitoring

The Fuel Research Board of D.S.I.R. took over the Atmospheric Pollution Research Committee on April 1, 1945, and expanded its scope of activity to include work on smoke elimination at source by the removal of grit and  $\text{SO}_2$  from chimney gases.<sup>83</sup>

At the end of 1958 D.S.I.R. closed down their Fuel Research Station and transferred responsibility for air pollution to the newly-created Warren Spring Laboratory. This body was charged with:

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- 81. MACPHERSON, A. 1963(a).  
A study of air pollution in Edinburgh.  
J. Edinburgh University Geog. Soc. 12, 7-9.
  - 82. CROSBIE, A.J., CROSBIE, N.J. and DICK J.H.A.  
Air pollution in Edinburgh, Pt. I M.S.S. 1968;  
Pt. II M.S.S. 1970;  
Pt. III M.S.S. 1971.
  - 83. Fuel research. 1939 to 1946.  
London. D.S.I.R. H.M.S.O. P.35.

- a) the assessment of distribution and dispersion of pollutants in the U.K.;
- b) investigation of chemical reactions in the atmosphere;
- c) assessment of accuracy and reliability of instruments used in surveys;
- d) recommending ways to reduce air pollution.

The laboratory assumed the duties of coordinating sampling procedures, collating and publishing monitoring data, publishing abstracts of relevant literature, and analyzing data collected. At the same time, the Scottish Branch of Warren Spring Laboratory, at Thortonhall, was given the task, among others, of establishing the accuracy and comparability of the various instruments then in use.

The instrument finally chosen for the main part of the National Survey was the continuous 24-hour smoke and SO<sub>2</sub> sampler.

#### LOCAL POLLUTION PROBLEMS

Smoke from St. Margaret's railway depot for repair and service of steam locomotives at Meadowbank was mentioned in the 1937 annual report of the Chief Sanitary Inspector as adversely affecting the new corporation houses at Piershill. In normal circumstances, no single engine emitted sufficiently dark smoke for prosecution. The problem arose from the large number of locomotives, the low-lying area of the depot, and the low emission height. Prevailing wind brought smoke from the depot across the nearby housing development causing blackened stonework and inconvenience due to grit. With the exception of the war years, annual representations were made to the railway, but the problem persisted. In 1962, Chief Sanitary Inspector

Dunbar reported a monitoring exercise in which two automatic filtering machines were operated, one inside a bedroom in Restalrig Road South, and the other outside the house in the open air.<sup>84</sup> The bedroom window was kept about two inches open. The two sets of data agreed closely, with indoor values peaking at  $3400\mu\text{g}/\text{m}^3$ , during light westerly wind. It was concluded that, unless sealed, windows offered little barrier to the movement of pollution. To dramatize the findings the Chief Sanitary Inspector undertook a calculation comparing the deposition at Piershill with that in the Sighthill smoke control area, concluding that it would take 270 years for the smoke control area to receive as much deposited dirt as Piershill received annually. Improvement at St. Margaret's came only with the gradual retirement of steam locomotives, a process which was completed by 1966.

Some insight into the kinds of pollution sources which caused trouble in the city is provided by the annual reports of the M.O.H. and the Chief Sanitary Inspector, from which Tables 6-3 and 6-4 have been constructed.

In the period 1930 to 1969 premises classified as "offensive trades" decreased from twenty-seven to twelve. The group, at various times, contained tanners, gut-scrapers, glue and size manufacturers, soap boilers, tripe cleaners, manure manufacturers, fellmongers, tallow-melters, and skin and hide factories. Those remaining in 1969 were not entirely innocuous, as a petition was received about smell from a plant for processing animal

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84. Chief Sanitary Inspector's annual report. 1962.

offal into pet food.

The number of cases requiring Health Department involvement in nuisances due to smell and smoke within homes and shops has declined since the war. Slum clearance and modern housing schemes, plus higher living standards undoubtedly contribute to this trend.

In the earlier days of smoke control one of the duties of the Health Department was to observe smoking chimneys, and by comparison with a smoke density chart, to time the number of minutes of "dark" or "black" smoke per hour. This activity persisted in Edinburgh into the 1960's but has now been replaced by a patrol system in which both industrial and domestic sources are regularly checked for excessive smoke.

The frequency of complaints regarding air pollution was not published after the last war, but these still had a role in the Health Department's work. References in M.O.H.'s annual report to such specific problems as dust from sawdust grinding, animal offal processing, and noise, mention that involvement of the Department was initiated by complaints. <sup>85</sup>

Inspection visits to factories fluctuate widely, but remain more than 100 per year during the period under consideration. <sup>86</sup> These visits were to advise boilermen on methods of reducing smoke emission and to suggest to owners possible smoke and fuel-saving plant changes.

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85. E.g. 1947 and 1948.

86. Chief Sanitary Inspector's annual report. 1966.

# THE CLEAN AIR ACT OF 1968

During the first decade of its operation the need for a number of revisions to the Clean Air Act of 1956 became obvious. To this end, in May of 1967, Mr. Robert Taylor introduced a Private Member's Bill in the House of Commons.<sup>87</sup> This Bill was withdrawn after second reading in favour of government legislation proposed by Mr. Robert Maxwell, which received Royal Assent on the 25th October, 1968, with certain clauses to become law on 1st April, 1969.<sup>88</sup>

This Act gave the Minister (Secretary of State for Scotland) powers to regulate emissions of "grit and dust". In effect, it formalized some existing regulations<sup>89</sup> which had grown out of the report of the Working Party of Grit and Dust Emission.<sup>90</sup> It also made explicit the procedure to be followed in obtaining approval for new or remodelled chimneys. The Minister received new powers to regulate "fumes" and to require local authorities to establish smoke control areas. If action were still not forthcoming, he could assume a local authority's powers for this purpose. Under the revised Act it became an offence to sell or purchase unapproved fuel for burning in a smoke control area. In all cases, the maximum penalties for offences under the 1956 Act were increased. These revisions

87. The Bill was not printed.

88. Clean air act. 1968.  
Public General Statutes. 16 Elizabeth II. C.62.

89. E.g. 52/68 S.D.D.; 48/67 S.D.D.

90. The measurement of emissions from boiler and furnace chimneys.  
H.M.S.O. Scottish Development Department. 1967.

came into effect in two stages for Scotland: the first was April 1, 1969; <sup>91</sup> the second October 1, 1969. <sup>92</sup>

## SUMMARY AND CONCLUSIONS

### The National scale

As in the earlier period discussed in chapter five, it is hard to over-estimate the importance of the smoke abatement societies in bringing about pollution control. The air monitoring project initiated by their officials as a public relations tool has now grown into the National Survey. The National Smoke Abatement Society journal was the first to be devoted exclusively to air quality. From this platform the Society was able to put forward the "smokeless zone concept", which was the basis, in part, for control of domestic sources under the Clean Air Acts. Although the Society did seek to influence the general public through occasional exhibitions, in the main it marshalled its meagre resources in an effort to persuade those in positions of influence. To this end the Society published "speakers' notes", helped Members of Parliament to prepare bills, and carried on correspondence designed to prod local authorities and government officials to action. When the great smog came, it was possible to build immediately the structure of control legislation which popular concern demanded, because a strong foundation had already been laid by the Society and by past governmental study commissions.

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91. 8/69 S.D.D.

92. 49/69 S.D.D.



There were also certain large scale influences which had profound implications for smoke control. Most obvious of these were the wars, during which smoke control had no priority, except insofar as it related to fuel efficiency. In a similar way, the "economic wars" of the depression, post-war recovery, and the recession of the late sixties all oriented priorities away from smoke control. Associated with these, was the very real constraint imposed by the shortage of solid smokeless fuel. Smoke control under these circumstances understandably evoked vehement opposition from coal merchants who saw it as a threat to their personal security. Successive governments had to balance these fears against the warnings of the National Smoke Abatement Society. But the balance had always to be struck with one eye on the necessity of maintaining a viable coal industry in the interests of national defence. For governments, pollution control was always a luxury, to be satisfied when less postponable demands were satisfied.

#### Edinburgh

Pollution control has never been a popular cause in Edinburgh. Although the M.O.H. and Chief Sanitary Inspector have, to a man, been enthusiastic, there is a limit, in practical terms, to what they can accomplish without the active support of Public Health Committee members, particularly the chairman. There is evidence of public opposition to the first smoke control areas in the city, not only by insecure coal merchants, but also by ordinary citizens, as illustrated by Mr. Thomson's petition signatures. The absence of objectors to recently

announced smoke control suggests that public response has changed to an apathetic acceptance of smoke control as a "good thing".

This state of quiescent approval is a vindication of the Corporation's smoke control plan, which was a long-term compromise among the forces operating. The large areal gains in the suburbs pleased the government who wished to see evidence that local authorities were complying with the Clean Air Act. The Corporation kept costs down by allowing existing trends in fuel use to "soften up" the high density areas of the city, while concentrating the initial stages of the programme on the newer, lower density, suburban areas in the west. The benefit of the programme, such as it was, was passed over the city by the prevailing winds. Implementation was slowed by opposing councillors to allow maximum chance for solid smokeless fuel to take a more substantial share of the conversions. The coal merchants' plight was also eased by the Public Health Department's policy of treating violations with repeated warnings and conciliation rather than by recourse to the legal sanctions available.

By comparison with the sources of former years, the present pollution situation in Edinburgh must be a marked improvement. Offensive industries are down in number; trains are now diesel; smoke control is well under way; urban renewal in Leith and the central city are making inroads on former "black areas". When the relatively easily observed problem of smoke is removed, however, the next focus of attention is frequently smell. Edinburgh would seem to be approaching this stage, and the obvious target is the increasing volume of traffic exhaust.

### Conclusion

These brief historical summaries, chapters 5 and 6, complete the review section of the project. The studies outlined in chapter four suggest basic methodology, while the reviews of "perception" in psychology and geography provide concepts and points of view that have been found useful in past work of a broadly similar nature. The assessment of contemporary human adjustment to air pollution seems more closely related to the "natural hazards studies" than to any other area of behavioural geography. For this reason, it seems advisable to look in more detail at the theory of human response to environmental threats as it has evolved from natural hazards research, with a view to its modification for use in assessing present perceptions of air pollution in Edinburgh.

PART III THE EDINBURGH CASE STUDY

## Chapter 7

### AN ASSESSMENT OF NATURAL HAZARDS THEORY WITH REFERENCE TO AIR POLLUTION AND COGNITIVE BEHAVIOURAL ASSUMPTIONS

#### INTRODUCTION

Most researchers, in the studies reviewed in chapter four, considered air pollution as an environmental hazard. In the main, they sought to place an individual's ideas about air pollution along a continuum of awareness, which extended from no recognition at all to awareness of air pollution as a direct and personal threat. These subjective assessments of risk were compared with similar response regarding landslides, forest fires, and severe storms.

The implicit assumption is that the threat imposed by air pollution is similar to that resulting from obviously natural hazards such as hurricane, flood, and avalanche. If this assumption is valid and air pollution can be treated as a natural hazard, the work carried out by Gilbert White and others can be used legitimately to investigate perceptions of air pollution. To test this, the following discussion seeks:

- a) To assess the degree to which air pollution may be classified as a natural hazard;
- b) To evaluate existing natural hazards theory with reference to air pollution.

#### WHAT IS AIR POLLUTION?

Of the many possible definitions, "air pollution" is taken, in this study, to mean the presence in air of any matter or energy level whose effects are adverse to man's purposes, and whose quantities are greater than those normally present in natural air at the given

location and over a given period of time. Although air pollution may be construed from social, economic, and political viewpoints, the focus here is on the physical phenomenon because it is this which is most amenable to objective estimate on the basis of emission inventories, dispersion calculations, and air sampling programmes. The definition is man-centred in that it involves only effects known to be adverse to human purposes; unrecognized, latent effects are excluded.

As well as the familiar man-made sources associated with accidental fire, fuel combustion, industrial processing, and agriculture, air pollution may also include natural phenomena such as dust storms, and volcanic activity. Also included are abnormal energy levels such as noise, and unusual extremes of temperature, or radiation.

Air pollution may be identified as a global phenomenon or on the smallest scales, it may occur in ambient or enclosed environments. For example, at the one extreme world concern with radiation pollution produced the nuclear test ban treaty that all but ended the detonation of nuclear devices in the free atmosphere; <sup>1</sup> at the other, a New York sports shop was prohibited from compressing air for sale to scuba divers because the product being supplied for use in this most enclosed and "micro-air" environment was a dangerously concentrated smog.

Different kinds of pollution may be conceived as potentially interpenetrating parcels of air having different volumes and characteristics. These may interface with each other and with a varying surface area. The union of pollution parcels may produce new contaminants, as when ammonia and sulphur dioxide combine to produce ammonium sulphate, a persistent compound in many urban smogs, or when radio activity

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1. France is not a party to the test ban treaty and is currently testing nuclear devices in the free atmosphere over the South Pacific.

contaminates dust particles.

Each contaminant will have generative locations and processes, and areas and mechanisms of removal, or, in the case of energy levels, of decay. When generation is greater than removal for any pollutant, its atmospheric concentration must increase, either ephemerally and locally, or more persistently and through a larger parcel of air. If matter is removed or energy decayed before human uses have been impaired, air pollution, in the terms of the definition used here, has not occurred. The capability of natural systems to remove waste without the occurrence of pollution is least over cities.

Man thus has two roles with regard to air pollution: his waste emissions reinforce and interact with natural cycles; and to the extent that his presence and purposes are threatened, he is the arbiter of the existence of pollution at any given time and place.

#### CAN AIR POLLUTION BE CLASSIFIED AS A NATURAL HAZARD?

On the basis of past studies of flood-plain and storm-prone sea-shore occupancy, attitudes in drought and frost areas, and response to snow disruption in cities,<sup>2</sup> Kates defines a natural hazard as ". . . a threatening state to man, compounded of an expectation of future occurrence of natural events which impinge on a human use system that is provided, through adjustments, with a certain capacity to absorb these events."<sup>3</sup>

Superficially, air pollution seems to qualify as a natural hazard. It too is viewed in anthropocentric terms. Meteorological occurrences, such as prolonged calms and low-level inversions, play an undeniable role in the build-up of pollution. An "expectation of the future

2. Pp. 3-9 to 3-15.

3. KATES, R.W. 1970. Natural hazards in human ecological perspective: hypotheses and models. Toronto. Natural Hazards Research. Working Paper No. 14. P.15.



occurrence" of such conditions is possible for most parts of the world based on existing meteorological records and forecasting capacities. That air pollution "impinges on a human use system" is obvious to anyone who has withdrawn from an unpleasant odour or been chagrined to find his freshly washed car dotted with black smuts. Equally, it is plain that people do not stop breathing where air pollution exists, although they may act to minimize exposure. Hence a capacity to absorb is demonstrated. Thus air pollution seems to fit the definition of a natural hazard.

But there are also points of disagreement. With the exception of drought, the hazards with which Kates is concerned are external to the resources being used. Although visibility reductions and certain meteorological phenomena affect land use directly, most of the hazardousness of air pollution results from the use of air itself as a resource. These uses include, among others, waste disposal, respiration, visual and auditory medium, necessary host of natural cycles in whole or part, and protective envelope against radiation from space.

Areas affected by air pollution are more difficult to define and more variable in extent than are the risk areas associated with Kates' principal defining hazards, flood-plain and sea-shore damage. In the latter, low-lying ground is vulnerable if located in the broad area known from past experience to be subject to the storms. However, for air pollution, the area at risk from a volcano, for example, may be at any elevation and in any direction from the source depending on the wind and stability conditions prevailing throughout the eruption.

In contrast, in the extremity of the urban air pollution threat, the "episode" (Table 4-1), it is frequently possible to delimit the affected zone with some precision. Recently, accidents with noxious

chemicals in Christchurch <sup>4</sup> and Chicago <sup>5</sup> have forced such demarcations so that threatened inhabitants could be evacuated. Much less obvious in extent are the larger areas affected by the prolonged presence of lower concentrations, often in uniquely place-specific combinations and with unique synergistic potential which may be enhanced or limited by local atmospheric conditions. At this end of the exposure continuum accurate monitoring becomes extremely difficult and cause and effect linkages are inextricably entangled in webs of multiple causation.

The effects of pollution, even of sustained low concentrations, have been shown, in scientific studies, to damage vegetation, <sup>6</sup> materials, <sup>7</sup> and human health, <sup>8</sup> while under suitable meteorological

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4. 28 February, 1973.

5. 19 and 20 March, 1973.

6. E.g.:

LANPHEAR, F.O.

Air pollution injury to plants in St. Louis.

Preprint. A.P.C.A. Pittsburgh, Pa. 1970;

DREISINGER, B.R.

The impact of sulphur dioxide pollution of crops and forests.

Pollution and Our Environment. Conference background papers.

Volume 1.

Montreal. Canadian Council of Resource Ministers. 1967. Paper A4-2-1.

7. E.g.:

MUNN, R.E.

The impact of air pollution on property.

In Canadian Council of Resource Ministers. Background papers prepared for the national conference on Pollution and Our Environment. Ottawa. Queen's Printer. 1966;

ABE, H., ISHII, Y., and KATO, H. 1971.

Evaluation of atmospheric factors by analysis of corrosion products and surface deposits on copper plates.

Railway Tech. Res. Inst. Quart. Repts. 12 (3), 170-174.

8. E.g.:

ANDERSON, D.O.

Effects of air contamination on health.

In Canadian Council of Resource Ministers. Background papers prepared for the national conference on Pollution and Our Environment. Ottawa. Queen's Printer. 1966;

WARNER, C.G. 1969.

Bronchitis in two integrated steel works. II Sulphur dioxide and particulate atmospheric pollution in and around the two works. Ann. Occup. Hyg. 12, 151-170.

conditions and emission density, episodes of higher concentrations may cause markedly reduced visibility and bring physical discomfort, or even death, to the aged or those with respiratory weakness. Only in the latter rare cases is air pollution closely similar to the hazards with which Kates is principally concerned, wherein the onset of effects are sudden, obvious, and dramatic in their interference with human activity.

Man's active role in creating an air pollution hazard is somewhat analagous to the seashore residents' removal of protective sand dunes in order to gain a better view; by removing this natural protection they increase the risk of flood and storm damage. Here, then, human action works in concert with the natural events system to create risk. Similarly, human waste input to air, particularly in urban settings, overburdens natural air-purifying mechanisms, with resulting pollution hazard.

Such air pollution situations, being of largely human cause, are more amenable to control than are other natural hazards. In the limiting case, cessation of waste input during an episode eliminates further build-up of pollution. By contrast, a hurricane, tidal wave, or blizzard defies human control.

If air pollution is to be considered as a "natural hazard" certain significant differences from the familiar natural threats must therefore be borne in mind:

- a) The hazard of air pollution has a strong causal component of human action, particularly in cities, where most pollution episodes have occurred in the past;
- b) Air pollution is seldom sudden and dramatic in its impact, and its presence must often be detected by sensitive machines rather than by human perception;

- c) Many of the effects of long-term exposure to relatively low concentrations of air pollution are masked by the presence of other contributing factors;
- d) Air pollution can be ignored at most times and in most settings - a hurricane or a landslide cannot.

#### GLOBAL HYPOTHESES AND AIR POLLUTION

These hypotheses follow from a man-nature interaction in which a human use system interfaces with a natural system to produce a hazard of varying magnitude and frequency.<sup>9</sup> Human response to the hazard, i.e. "adjustments", are seen to vary with the technological and social stage of the society, with the specific hazard involved, and from individual to individual.

Although deaths from volcanic gases and ash have been recorded for thousands of years, air pollution, as a relatively persistent, and quasi-man-made phenomenon, is essentially a modern, industrial, urban creation, which has developed, mainly in the last one hundred and fifty years, in response to a concentrating, burgeoning population, consuming fossil fuels at an increasing rate. In former times such levels of pollution were encountered only indoors. Therefore, Kates' distinction among different stages of society - "folk or pre-industrial, modern technical industrial, and comprehensive post industrial" - as to their adjustment to hazard is not useful for air pollution.

Kates hypothesizes that individuals and groups will evaluate possible adjustments to hazards in terms of "technical feasibility, economic gainfulness and social conformity", as well as "personality"

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9. KATES, R.W. Op. cit. Pp. 3-9.

effects. For air pollution the most crucial factor follows from the indirect nature of the threat it poses in most instances. One must learn the cause and effect relations involved, because these are not unambiguously demonstrated in the environment. Once this learning step has been accomplished a search for "adjustments" may be initiated within the constraints imposed by the individual's life situation and personal priorities. It is at that stage that Kates' hypothesized factors may come into play with reference to air pollution. Thus, the large variability in individual responses to objectively equal pollution levels that has been encountered in past studies may result more from differential information receipts than from variations in direct experience. However, once learning about pollution effects has taken place, the observation of these will follow automatically as attention is directed to known elements of environment.

Certain "critical features of the natural events system" are suggested as causes of different adjustments. These are: frequency of occurrence; magnitude of energy release; and suddenness of onset. A fourth point concerns the intrinsic relation of the hazard to the use characteristics of the site. If consideration is confined to "episodes", that is those relatively short periods of severe pollution intensity, three of the four items could apply; only the magnitude of energy release is irrelevant to air pollution in that context.

But there is a problem of definition. Threshold concentrations of specific pollutants that are associated with episodes in a particular time and place may not constitute an episode at a different time or in a different location. For example, hydrocarbon emissions in Los Angeles, at night, may be carried away and dispersed by morning,

whereas, if emitted during the day, photochemical reactions could ensue with resultant "pollution". An equal emission of hydrocarbons in a high latitude setting, at any time, would be most unlikely to take part in sufficient photochemical reaction to be designated "smog".

The hazard of air pollution operates on a time scale ranging from minutes for toxic vapours, to days for urban "episodes", to months or even years for lower level exposures. It is the last hazard that is least obvious in its presence, and bears least relation to the sudden cataclysmic forces which are the main basis for Kates' theory.

Despite these limitations, the general systems model of "human adjustment to natural hazards" (Figure 7-1) offers a useful way of looking at the process by which pollution effects are buffered. Although air quality has implication for everything man does, there is flexibility in the use system, allowing avoidance of adverse effects. Insofar as most pollution problems are closely confined to areas near emission sources, the option to move away remains open, at least until possible global pollutants begin to have an impact. There is also scope for in situ limiting of hazard effects. Short term, or "emergency" adjustments, such as using a handkerchief as an air filter, or taping windows shut, may give way in the longer term to some attack on the problem's causes, such as efforts to limit emissions within one's own control, or campaigning for tighter restrictions. Any adjustment must focus on changes in the human use system, because changes in the natural systems, on anything but the most local scale, would require energy releases of such magnitude as to be currently impossible, and, in any case, undesirable.

The final "black box" in Figure 7-1, "adjustment process control", represents a complex mechanism describing influences on how an



individual:

- a) recognizes the phenomenon, and;
- b) decides what, if any, action he will undertake.

This mechanism involves assumptions about how people learn in their environments. Before the "adjustment process control" can be discussed in any meaningful way it is, therefore, necessary to attempt a statement of the cognitive behavioural assumptions underlying this interpretation of Kates' hypothesis.

#### COGNITIVE-BEHAVIOURAL ASSUMPTIONS

There is little new in the outline which follows; it draws on psychological perception theories (Chapter two), on their geographical restatements (Chapter three), and to some extent on introspection. Although parts of the structure might be referenced, it is essentially an amalgam hypothesis of how environmental learning occurs. It constitutes an attempt at the goal Lowenthal set more than a decade ago: the enunciation of a geographical epistemology.<sup>10</sup>

The schema begins with a conception of man based on need: physical need and mental need. (Figure 7-2) These are the basic minimum essentials for the survival of the person. An excess in any area may constitute pleasure or pain, but a deficiency may only be tolerated in a short term of variable duration, depending upon the need involved and upon its substitutability.

In the main, needs are satisfied by inter-action with environment, under the direction of mind. The mind is a structure of interrelated, information-bearing "capsules", which may be, in some degree, innate

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10. LOWENTHAL, D. 1961.  
 Geography, experience, and imagination: towards a geographical epistemology.  
 Annals, Assoc. Am. Geog. 51 (3), 241-260.



but certainly are elaborated by experience, both in terms of their numbers and of their individual complexity. Such capsules store the residue of subjectively interpreted experience and take on central or peripheral importance according to the directness of their linkages with the central need structures. Each member of this hierarchy of capsules carries with it a series of "control parameters", symbolized in Figure 7-2 as dots. These define:

- a) The range and application of the stored information;
- b) Its probability or reliability;
- c) An affective component, i.e. whether it is considered good or bad in terms of its utility in attaining past goals, and how good or how bad;
- d) Linkages, of varying strengths, of this capsule with others in the mental complex.

The more directly a capsule is linked with an element of mental or physical survival, the more importance, the greater value, it takes on. Value systems function through the linkages.

Capsules can be aggregated at will, or in unconscious response to cues, producing, for example, a mental map of part of a city, or a critical path outline of how to survive in a particular organization.

Which of the central needs will be foremost at any particular time depends, in part, on inputs from the body's internal monitoring system; and in part, on the existing state of mental balance. If the essentials of both physical and mental needs are satisfied, then less crucial, pleasure capsules may take priority.

This structure is in contact with the environment via the senses. Sense arousal depends upon the state of the person, i.e. upon the needs that are currently most pressing, while the character and quality of sense function depends upon the existing adaptation level of each

sense. It is by episodic interaction with environment, directly via first hand experience, and indirectly via representations of others' experience, that mental structures evolve through life. The structure may well have considerable rigidity in the sense that capsules and linkages added at early stages are resistant to change. Yet at the same time, there is a migration toward the periphery of capsules whose functional utility is diminished. That is not to deny that one may be able to think one's way back to an earlier mental structure. Past experiences may be re-evaluated through the wilful exercise of memory - by reflection. In this way too "new" information may be added to the capsules.

What is the use of such a schema? Its first advantage is with definitions: "images" are the capsule boxes, or their aggregates; "culture" is the capsules and their linkages that are held in common with others. Thus culture could be abstracted on scales ranging from mankind as a whole, down through nation, region, town, neighbourhood, family, and, ultimately, to individual culture which is "personality". In another way, personality results from the totality of the hypothesized structure and is the face presented to the world in order to achieve subjective needs.

The model can be used to specify research areas. The Stimulus-response school focus on "senses", "action", and "attention point", in a simplified context. (Figure 7-2) Gestaltists and Functionalists include reports and inferences about what goes on in the mind, as well as a greatly expanded contextual frame. Geographers have been concerned with specific concepts, or their aggregates, as well as with the various "control buttons" indicating reliability, range, affect, and linkages.

With regard to "air pollution" the relevant capsules might be related to physical survival, to amenity, to personal exploitation, or to a concept concerning the morality governing the use of such common property resources as the air in a public room. On the other hand, air pollution might constitute a very weak capsule, unrelated to any of the major needs. In this case, perception of air pollution might well be blocked at the senses as irrelevant, because a prime function of the perceptual process is to prevent the mind from being overwhelmed with irrelevant stimuli.

With these cognitive behavioural assumptions as background it is now possible to evaluate Kates' adjustment process model (Figure 7-3) with reference to air pollution.

#### ADJUSTMENT PROCESS MODEL

New variables that seem particularly relevant for air pollution are added in the discussion below, which treats the parts of the model in order and suggests structural changes, that are summarized in Figure 7-4.

#### Personality factors

Attitudes to nature are peripheral to human response to air pollution insofar as natural events are peripheral to the problem itself. Although natural events - calm, stable, persistent weather - are necessary for severe pollution build-up, human waste input is the obvious major cause.

Risk-taking propensity is most relevant for the flood-plain farmer who plants his crop knowing that it may be destroyed two years out of ten, or the beach house owner who charges high rents to recoup investment plus profit before the next storm. Those are in a totally

different situation from the inhabitant of an air pollution prone city. "Risking" air pollution may bring, to the ordinary resident, marginal gains in prices and consumption, but these are usually unrecognized. They may also be more than offset by equally unrecognized effects: deterioration of health, material and aesthetic experience. Moreover, air pollution is present, to some extent, and producing its effects at most times. Therefore, residents have no hope of escaping the adverse effects while enjoying the benefits. Thus, the air pollution threat makes no appeal to gambling instincts, beyond, perhaps, the temptation to trade assured income from working in a "polluted" city against possible, but ignorable, adverse effects.

Fate control appears to have little relevance to human response to air pollution, even though appeals to the supernatural have been noted in response to other "natural hazards". Air pollution problems are, in the great majority of cases, obviously human creations. It should be noted, however, that such effects may be important in areas threatened by natural pollution sources as is currently the case in parts of Iceland.

Cognitive dissonance effects arise when two or more beliefs in some way contradict each other. With regard to air pollution, such an effect could occur for individuals who are aware of breathing polluted air and at the same time know of potentially adverse health effects. According to Festinger's observations <sup>11</sup> the dissonant state should produce action to lessen the perceived contradiction, for

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11. FESTINGER, L. 1958.  
The motivating effect of cognitive dissonance.  
In LINDZEY, G. (ed.)  
Assessment of human motives.  
New York. Holt, Rinehart and Winston. 1961. Pp. 65-86.

example:

- a) Withdrawal from exposure;
- b) Action to reduce pollution input;
- c) Denial of health risk;
- d) Recognition of a general health threat, but denial of its personal effect.

If one were very concerned about external threats to one's health, awareness of air pollution and its possible effects could produce a mental stress. Thus, as concern for personal health increases so too does the potential scope for cognitive dissonance, and for mechanisms of dissonance reduction.

Attitudes toward authority may also have relevance. If government is viewed as hostile, one will not look there for relief from a recognized air pollution problem. If, in addition, industry is held to be solely motivated by profit, there is no hope of improvement. Such despair would be expected to produce heightened mental stress, particularly if the respondent were also worried by possible effects. Such response could have a highly personalized focus on a particular local figure, or could be amorphous and general, specified only in terms of "the government", "the bosses", or "them". On the other hand, if such authorities are viewed in positive terms, their efforts at pollution control may well be seen positively also.

Fastidiousness may be important insofar as someone who is particularly concerned with cleanliness of home, car, or person may be more likely to notice air pollution.

Aggressiveness, in the sense of one's willingness to push back and defend oneself, would be expected to influence the threshold at which a risk is recognized and subsequently the choice and scale of

adjustment. If, for example, a householder considers the smoke blowing into his yard from a neighbour's bonfire as an infringement of his right to enjoy the use of his property, he is rather more likely to make some complaint, or at least to be upset.

Concern for family may be relevant since the most serious air pollution effects fall on a minority of the population - the very old, the very young, and those with respiratory ailments - it would be expected that concern about air pollution would be greater in households with members in these vulnerable groups.

The summary of these factors as hypotheses may offer a useful first step toward designing specific questionnaire items. Some of the relationships suggested are:

- a) Health effects are a major source of concern about air pollution.
- b) Air pollution is a nuisance to a significant proportion of the population;
- c) Relatively few of those bothered by air pollution complain to someone in authority about it;
- d) Most people believe that air pollution can be controlled;
- e) Governments are held responsible for pollution control;
- f) People are dissatisfied with the direction and speed of the implementation of pollution control;
- g) Those exposed to high pollution levels in their work environments will tend to deny the adverse effects of air pollution, and to hold strongly positive views on industry's control efforts.



### Life situation variables

Kates' inputs from "role responsibility" and "use unit characteristics" (Figure 7-3) are considered here as part of a grouping of "life situation" variables. (Figure 7-4) This heading subsumes such respondent attributes as: subjective problem hierarchies; socio-economic characteristics; leisure time activities; and past residential experience. In the section that follows, each of these are discussed with reference to their influence on response to air pollution, and summarized by the research hypotheses which they are seen to generate.

A subjective problem hierarchy is assumed to exist for each person. Basic to the saliency of problems in this structure is the distinction between problems that are "my responsibility" and those that are "mine, but delegated to someone else". Of the former, some are more pressing than others, while the latter are of less direct, day-to-day concern. Stated in another way, this is a distinction between personal and community problems, wherein air pollution is recognized as a community-wide concern which must, therefore be looked after by some level of government. In effect, responsibility is surrendered to officials.

Healthy people in most places can ignore contaminated air with apparent impunity, and give precedence to pressing problems like housing and unemployment. However, when increasing awareness of a delegated problem occurs, a re-evaluation of that phenomenon's priority in the individual problem hierarchy may become necessary, as well as a re-assessment of its position on the continuum which ranges from totally personal to totally delegated concerns.

Socio-economic variables appear relevant despite Kates' conclusion that hazard perception is independent of "the common socio-



economic indicators (such) as age, sex, education, and income."<sup>12</sup>

It does seem from chapter four that some of these variables relate to interview responses on air pollution,<sup>13</sup> notably age and "class".

For the former, increasing age apparently inhibits awareness and concern; the latter may well involve a complex interaction of education, employment status, and income, and of their surrogates such as residence location, means of travel, and length and location of holidays.

Other broadly socio-economic attributes may also be relevant. Place and nature of employment have been discussed above as potential contributors to cognitive dissonance. But also, workers in a dirty industry may become more tolerant of grit, heat, and unpleasant smells, and by this habituation become less sensitive to amenity in surroundings generally. Conversely, those working in electronics assembly, or a pharmaceutical plant, would be expected to have heightened perception of anything "in" the air. In certain jobs adverse health effects of air pollution are well known. This knowledge may overcome economic and habit factors to produce concern. A coal miner, for instance, could ignore outside air pollution as insignificant compared to job exposure, or could recognize the threat more readily, because of job-gained knowledge. Air pollution could be considered more serious personally, since effects would be cumulative. Therefore, employment experience may well be a complex influence on response to pollution.

Although there has been no consistent influence observed for home ownership<sup>14</sup> and smoking<sup>15</sup> in other studies, intuitively these

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12. KATES, R. Op. cit. P.6.

13. P. 4-36.

14. P. 4-34.

15. P. 4-35.

seem relevant, if only to identify respondents who make a causal connection of air pollution with damage to personal property and health.

Among other socio-economic attributes considered relevant are the respondent's physical health, his leisure activities, and his past residential experience.

Those having respiratory diseases and/or impairments would be expected to be more concerned with air pollution, because of its direct personal impact. On the other hand, those having sensory deficiencies would be partially cut off from direct and/or secondary experiencing of effects, and possibly would be less concerned.

Leisure activities are considered here as time employed in other than the work role. Hobbies could bear on awareness of air pollution insofar as they supply access to esoteric information. Similarly, time spent in holiday and week-end travel could provide perspective on Edinburgh's problems; in this case basis for comparison of local air pollution with that of other places. Membership in clubs and organizations might suggest community involvement and add a dimension of information access.

Past residential experience is included as possibly defining a standard against which the current setting may be judged. Conversely, a person who has spent his whole life in an urban setting may be inured to the presence of air pollution, and be unaware of it due to habituation effects.

In summary, the above discussion of variables pertaining broadly to the respondent's life situation suggests these hypotheses:

- a) Air pollution has a place in subjective problem hierarchies;
- b) Socio-economic factors are related to responses about air pollution.

Communication access

The basic hypothesis involving information access is that greater exposure to information flows produces an elaborated air pollution concept of higher saliency. Operationally, the testing of this hypothesis involves assessment of television and radio use, newspaper availability, and recall of items dealing specifically with air pollution.

Individual air-use experience

This category replaces "personal hazard experience" (Figure 7-3) and is intended to reflect the persistent and general character of the air pollution threat in contrast to the markedly place and time specific risks with which Kates was primarily concerned.

Hypotheses suggested here involve mainly subjective assessments of pollution in its definition, presence, and intensity, and include the following:

- a) "Air pollution" is a readily defined concept for most people;
- b) Opinions about air quality agree substantially with monitored pollution levels;
- c) People are aware of the adjustments that may be made during severe pollution;
- d) Those who are satisfied with their home area in a general way will be more likely to consider air pollution as a serious local problem.

CONCLUSION

Natural hazards theory, as presented by Kates, appears to offer a useful perspective on the perception of air pollution, if it is adapted in certain ways.

This adaptation, and the review of past studies presented in chapter four, suggested hypotheses that could be tested profitably in the Edinburgh case study of the perception of air pollution. These hypotheses included the comparison of perceptions with "reality", as defined by available air monitoring information, and involved variables arising from personality, life situation, information access, and air use experience. In addition the Edinburgh setting provided an opportunity to evaluate attitudes toward smoke control areas after ten years of their operation.

The most promising method of collecting the desired data, within resource constraints, was a sample survey using a standardized interview questionnaire. Accordingly, question items from former investigations were modified, and new questions tested, in three pilot surveys involving a total of twenty-five interviews during January of 1971.

The following chapter details the procedure that was subsequently employed.

## Chapter 8

### METHODOLOGY

#### Sampling objectives

In broad terms, the sampling strategy was to make a representative selection of respondents, and yet, to have data that would be maximally comparable with that of other studies. Socio-economic variation, within the sample, was desirable, since a number of hypotheses involved such variables as age, sex, and education. It was necessary to assign each interview location to an "air pollution level" so that the hypothesized dichotomy between "real" and perceived pollution could be tested. At the same time, it was desired to maximize the population to which generalizations could be applied and to minimize sampling bias.

#### Criterion aerometric data

The information on air pollution that was available for the city consisted of an emission inventory of area and specific sources, compiled by the Air Pollution Survey,<sup>1</sup> and monitoring data from 24-hour smoke and SO<sub>2</sub> machines operated by the Public Health Department or by the Survey. Emission inventory data was not in a readily usable form, so attention was focused on ambient air sampling information.

These machines filter incoming air at a rate of approximately 70 cubic feet per 24 hours. The darkness of the resulting stain on the filter paper is related to smoke concentration by a

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1. CROSBIE, A.J., CROSBIE, N.J., and DICK, J.H.A.  
Air pollution in Edinburgh. Pt. 1. Ms. 1968.

reflectometer reading and tables specially prepared for Great Britain by Warren Springs Laboratory. Particulate matter of light colour has the effect of lowering the "smoke" concentration. The filtered air is bubbled into a standard sodium tetraborate solution. The resulting acidity of this solution is determined by titration. The strength of acidity and volume of air flow are related, again by Warren Spring tables, to yield a concentration of " $\text{SO}_2$ ". In fact, any dissolved acid contributes to the  $\text{SO}_2$  reading. The machines take no account of smell. Despite these shortcomings, the machine is suited to Edinburgh conditions where white particulate emitters are relatively rare, and  $\text{SO}_2$  from the burning of coal and oil is the major acid source. <sup>2</sup>

This data had the significant drawback of being specific only to its point location. Any generalization to surrounding area was closely limited by the city's marked topographic variation and frequent open spaces. Emission intensity, too, changed rapidly over short distances and with the diurnal, weekly, and seasonal emission patterns peculiar to the different source categories. Therefore, it was possible to make confident extrapolation of this point data to only a small, relatively flat, surrounding area of homogeneous land use.

#### Sampling alternatives

Four possible bases for the sample were considered: telephone directory; voters' lists; valuation role; geographical location.

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2. Scottish Agricultural Industries at Leith Docks would be an exception on both counts.

Telephone interviewing has been carried out with some success in a number of North American studies. There, however, a greater proportion of the total population have telephones and a freer attitude in their use prevails. It was felt that this approach would miss significant sectors of the Edinburgh population, principally among the poor and lower social status groups, and that some resistance would be encountered to questioning by a stranger over the telephone. For these reasons, telephone interviewing and telephone directory based sampling were discarded.

The voters' list for Ward 1 was used as a basis for one pilot study.<sup>3</sup> This population included residents of rooming houses, nursing homes, hotels and University residences as well as ordinary householders. The lists included all citizens over the age of eighteen. The voters' list seemed to bring a great variation to the sample, and made comparison of results with the majority of studies, which sampled "household heads", doubtful. (Table 4-2) On the positive side, a sample based on the voters' list could claim face validity, at least, in applying findings to voter behaviour.

The Valuation Role contains the addresses of all housing units, names of both owners and occupiers, together with the rateable value of the property. A sample based on the role would allow comparison with other major studies and would provide a less variable population since hotels, nursing homes and university residences, would be avoided. Both Valuation

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Role and Voters' List allow a procedure in which wards, and street names or polling districts, are selected by random numbers for a two-stage random sample. In such a procedure results could be applied to the whole city, within the constraints of sampling error. There remains, however, the difficulty of uncertain air pollution information for areas remote from air monitoring sites.

Selection by geographical location offers a number of possibilities. Random selection of coordinates within the city could serve to pin-point interview locations, areal cells, polling districts, or streets. If actual interview locations are chosen in this way, the sample would be biased toward single family dwellings on large properties, at the expense of high rise residences. When a multi-storey building is selected the problem of whom to interview remains. Random selection for areas, whether by coordinates or transects involves a secondary selection procedure and its attendant sampling error. At the same time, these methods retain the problem of discontinuous confidence in pollution monitoring data.

Whatever areal unit was chosen a number of sampling methods could be applied. A system could be adopted whereby a sampling fraction and a random starting point would dictate that interviews be attempted in, for example, every eighth house on each street, or on the first house on every third street, or some other combination. This involves knowledge of how many houses are in the population, and of where these are on each street. It is administratively difficult for the interviewer. Also, the first random number determines the whole sample since the

sampling fraction is fixed. Quota sampling can assure a desired age, sex, socio-economic distribution within the sample, but destroys the sample's claim to represent the proportion of the quota parameter in the group. If, however, the proportion of the quota parameter in the population is known, this technique can reduce sampling error.<sup>4</sup>

There appeared to be no "ideal" method of sampling for this particular study's purposes. A compromise, incorporating resource constraints as well as theoretically desirable features, was attempted.

#### Sampling procedure

After an examination of all sites where samplers had been operated, it was decided to compare data from the following: David Hume Tower, Windsor Street, Portobello Baths, Deanbank House, Carrickvale School, Royston School, Public Health Department, George Heriot's School, Weights and Measures, Leith Town Hall, Rodney Street School. (Table 8-1) The winter period, November to February, inclusive, was chosen because pollution levels are then generally highest as fuel consumption for electricity generation and domestic heating are at a maximum. (Figure 8-1) Other indices such as frequency of "high days" and episodes could be constructed later if required for analysis.

Each site was visited to evaluate the degree to which it represented its surrounding area. On this basis, David Hume

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4. A useful discussion of sampling techniques is contained in: Moser, C.A.  
Survey methods in the social investigation.  
London. Heinemann Educational Books Ltd. 1958.

Tower was eliminated since intakes were mounted at various heights and orientations on the twelve-storey tower. Also, its winter data was incomplete. Astley Ainslie and Windsor Street had only one year in common with the other sampling sites and so were rejected. Although George Heriot's School, Public Health Department, and Weights and Measures were operated to investigate effects of topography on air pollution levels, if taken together the three sites give a useful smoke and  $\text{SO}_2$  average over the irregular natural and built topography which characterizes the central area of Edinburgh.

Royston School (Granton) is in the midst of a council housing scheme, hence likely to offer minimal socio-economic variation in its surrounding area. The large coal consumption at Granton Gas Works <sup>5</sup> undoubtedly affected the Royston School data to make it unrepresentative of present conditions. This data was eliminated from further consideration.

After inspection, Portobello Baths, Carrickvale School, Leith Town Hall, Rodney Street School, Deanbank House and the three central city stations remained as promising focal points for sampling areas (Map 8-1). <sup>6</sup> Their relative pollution levels, as indicated by the common data period 1966-67, 1967-68 were checked against McPherson's distribution maps of 1963-64. (Maps 8-2 and 8-3) Relative positions were the same.

On the basis of further field examination, and with the help of 25-inch scale maps, an area of "reasonable extrapolation"

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5. Now discontinued.

6. Map 8-1 is contained in the pocket at the back of Volume 2.

was delimited for each monitoring site. These six areas were found to contain between 1150 and 1800 housing units. It was decided to "size" these to  $1500 \pm 15$  houses. For this purpose, a list of all houses within each sampling area was prepared from the Valuation Role. From each, a simple random sample of sixty households was drawn.

#### Administrative procedure

Since it was intended to aggregate and compare the ideas about air pollution that were expressed in these sample households, some form of standardized questionnaire was required. Its design would depend on the method by which it was to be administered. With telephone interviewing already discarded, three options remained: "drop off and pick up later", by mail, or face-to-face.

The interview that is to be completed by the respondent at his leisure, and collected at some later time by the researcher, must necessarily be in the nature of a "paper and pencil test". These results would be heavily dependent upon the reading skills, and, if open questions are to be involved, upon the written fluency of the respondent. A further drawback of this approach is that one does not really know by whom, and under what circumstances, the questionnaire was completed.

Mailed questionnaires are subject to variable, but usually low, rates of return.<sup>7</sup> There is some question whether the returnees truly represent the population, even though the total sample may have been rigorously chosen to be representative. Again, there is the problem of not knowing, for sure, whose views are expressed on the questionnaire, or the amount of attention

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7. Ten to forty percent.

given to answering it. Also lost is the opportunity of hiding the main focus of the interview during its early stages.

With face-to-face interviews, one knows whose opinions are being recorded and can assess, to some extent, the respondent's interest in the exercise. Rapport can be built up during the interview so that more complete answers may be given to open questions. This approach also avoids the "written test" situation which some respondents find threatening. The main drawbacks of face-to-face interviewing are its cost and the variability of interviewers. Despite these, it was decided to use the face-to-face approach.

Five extra households were assigned for each sampling area to serve where contact had not been made after three visits, a refusal was given, or a selected house had been demolished or was vacant. In this way a total of sixty completed interviews was obtained for each of the six sample areas.

#### The interviews

Fifteen interviewers were employed from March first to fourteenth, 1971. These ladies had been trained by Marplan (a market research agency), the central government, or by the Social Science Research Unit of Edinburgh University. Most were married and did interviewing as a part-time job-cum-hobby. It was considered a reasonable risk to pay on a piece-work basis of sixty pence per completed questionnaire. (Appendix 4)<sup>8</sup> An hourly rate, though desirable, was not possible because funds for research costs had to be borrowed in advance, and could not

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8. Appendix 4 is contained in the pocket at the back of Volume 2.

be extended. Since these were trained people, only one organizational meeting was held.<sup>9</sup> Their oral instructions, and the Interviewers' Manual given to each, are contained in Appendices 2 and 3.

Although ideally each interviewer would work in each sampling area, this was not possible due to the travel costs. The best that could be done was that each worked in the two areas nearest her home, with the instruction that no-one was to interview an acquaintance or friend. Completed questionnaires were to be returned in bunches of three to five. In this way a check on progress and on any systematic error in administration could be made. Interviewing was completed within the assigned two-week period, during which time pollution levels in the city were relatively low. (Figure 8-2)

The second set of interviews were carried out between June first and fourteenth, 1971, by the same personnel, and following the earlier methodology. In this case the number of sampling sites was reduced by half to include only Portobello, Leith and Central City. It was felt that this still provided sufficient contrast of pollution levels, and allowed completion of sixty interviews in each area while staying within budget limitations.

This phase was financed through the Man and Environment Commission of the International Geographical Union, and constituted an extension of natural hazards research into the area of human response to air pollution. The questionnaire used

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9. February 23, 1971.

was designed in collaboration with Ian Burton, Mark Blacksell (Exeter), Geoff Wall (Sheffield). (Appendix 5)<sup>10</sup> Interviewing was carried out during the first two weeks of June, 1971, in each of the cities involved so that data would be maximally comparable. (Figure 8-3) A report of the collaborative dimension of the Edinburgh project is forthcoming.<sup>11</sup>

These data, 360 completed interviews in March and 180 in June of 1971, are analysed in the following chapter using joint frequency distributions to test the hypotheses suggested in chapter seven.

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10. Appendix 5 is contained in the pocket at the back of Volume 2.

11. BURTON, I. (ed.)  
Social response to air pollution in the United Kingdom.  
Toronto. University of Toronto Press. Forthcoming.



## Chapter 9

### RELATIONSHIPS IN THE INTERVIEW DATA

#### INTRODUCTION

In this chapter joint frequency distributions are used to summarize interview responses for the six sampling areas, and to test the hypotheses formulated in earlier sections. However, before proceeding with this, it is necessary to evaluate the nature of the data involved.

#### THE DATA

Since the shortcomings of interview information have been detailed elsewhere,<sup>1</sup> this brief discussion may be confined to some of the major sources of error bias. Any single interview is subject to error through variation in interviewer attributes such as training and dedication, and such chance influences on rapport as personal appearance, sex, and the convenience of the time of calling. Some of these influences may be increased or minimized by the administrative procedure employed, for example, method of payment, sample selection, and questionnaire content, structure, and phrasing. Some of the errors may affect only one interview; others may be involved in all the work of one interviewer. The administrative influences would be expected to operate systematically throughout the sample. Any one interview would be subject to a varying mix of error effects. Therefore, little weight should be placed on the validity of a single interview.

As single interviews are aggregated some of these errors, such as those arising from interviewer variation, may cancel each other

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1. E.g.  
MOSER, C.A.  
Survey methods in social investigation.  
London. Heinemann Educational Books Ltd. 1958.

out, and thus give increased reliability to frequency data. This, of course, does not apply to systematic errors built into the data-collection procedure. Even if systematic errors are not considered to be significant, sampling error must still be taken into account. The latter refers to the difference between the observed response proportion in the sample and the true proportion that would have been obtained if the whole population had been interviewed. For example, the possible variations in the observed proportions in Table 9-1 are indicated in brackets, for ninety-five percent confidence limits. The band of possible error for the ninety-nine percent level of confidence would be wider, for the ninety percent level, narrower. Appendix six contains an explanation of the procedure used in calculating sampling error, and some further examples from the data. Although confidence bands are not given in each of the tables which follow, it should be remembered that each proportion is bounded by a similar range of possible error.

Interview data may be characterized as either hard or soft. Hard data are responses to questions that have a definite and singular correct answer, for example: age, sex, education, address, place of employment. Soft interview data are answers involving opinion or personal knowledge, where a variety of "correct" answers is possible. Other things being equal, more faith may be placed in hard than in soft data, as more weight may be given to group than individual responses.

#### THE CHARACTERISTICS OF THE SAMPLE

The age distribution, in both March and June, is biased toward the over-forty-five grouping, with the modal category being forty-six to sixty-four. (Tables 9-2 and 9-3) Within the latter

category, the modal frequency is twenty-nine for Morningside in March, and the same number for Portobello in June. Morningside and Stenhouse have most older respondents, i.e. over forty-five years. In March, the frequencies of over-sixty-fours are approximately equal in each sampling area, with Portobello having slightly fewer (fourteen) and relatively more between thirty-one and forty-five. The fewest young respondents, i.e. under thirty-one, occur in Stenhouse, Portobello, and Morningside; the most in Bellevue and Central City. (Map 8-1) Overall, the proportionate frequencies in each age category are approximately equal in both interview periods.

An approximately equal sex balance was expected, because instructions were to interview alternately male and female heads of household. Slightly more females were interviewed in June, with the largest imbalance occurring in Portobello, where female respondents exceeded males by eight. (Tables 9-4 and 9-5)

Social class was assessed on the basis of occupation, according to the schema in Appendix one. Females were classified by the occupation of the man of the house. Where no male resided, or the woman was in full-time employment, the female's occupation was used.

The March sample is biased toward middle class; the June sample toward lower. (Tables 9-6 and 9-7) Among the sampling areas, Stenhouse, a corporation housing estate, shows up as a middle and lower class area, while Morningside has the most upper class respondents. The latter category shows a striking increase for Portobello and Central City in June, indicating the influence of sampling error.

Members of the sample who had completed secondary school or better are grouped in Tables 9-8 and 9-9 as having "high" educational attainment. Frequencies for Stenhouse, Leith, and Central City show a tendency toward less formal schooling; only Morningside has a majority in the top category. Due mainly to the influence of Morningside, the March sample has a greater proportion with higher education. Portobello, Leith, and Central City have almost identical distributions on the two occasions.

Income was queried directly only in the June sample. (Table 9-10) Annual receipts of over £2500 were classed "high"; £1000 to £2,500, "medium"; and below £1,000, "low". Among the sampling areas, the proportion of poor respondents seems to increase with the number in the oldest age group (Table 9-3), that is with the number on old age pension.

Both samples suggest a highly sedentary population, with approximately eighty percent residing in Edinburgh for more than twenty years. (Tables 9-11 and 9-12) Stenhouse and Leith have the highest proportions of long-term residents. These skewed length-of-residence distributions make it difficult to test hypotheses involving the comparison of newcomers' views with those of established residents, because cell frequencies on the newcomers' side are small.

At least a two-to-one ratio of owners to tenants obtained in Portobello, Morningside, Leith, and Bellevue, while Stenhouse and Central City had a heavy predominance of tenants. (Table 9-13) Although approximately the same frequency was maintained for Portobello and Central City in both samples, Leith showed a marked increase in renters in June. (Table 9-14) Overall, the first sample had a small excess of owners, the second, slightly more tenants.

Morningside and Bellevue respondents were most likely to rate their home area as "excellent" or "good": forty-two and thirty-eight percent, respectively. (Table 9-15). Leith, Central City, and Portobello gave fewest ratings in these categories. The latter also had most of the few ratings "poor", "very poor", or "intolerable".

Smokers are strongly in the majority in Central City for both samples and for Stenhouse in March. (Tables 9-16 and 9-17) The change-over in Portobello from March to June again illustrates the sampling error to which these frequencies are subject. Overall, there is an approximate balance between users and non-users of tobacco.

In March only, respondents were asked how much time they spent outside Edinburgh during the previous twelve months. (Table 9-18) In this way it was hoped to obtain some indication of their basis for comparison when speaking about Edinburgh. Although one-sixth of the sample had not been out of the city at all, the majority (58.3 percent) had been away for more than two weeks. Stenhouse and Central City had most non-travellers, while the more affluent Morningsiders spent most time away from Edinburgh.

Occupations were classified according to the amount of air pollution likely to be encountered in the work environment. For example, chemical workers, stokers, miners, and dockers were grouped under "dirty" jobs, while clerical work, teaching, and the professions were assigned as "clean". Bellevue and Morningside have higher proportions with clean jobs. The other areas have approximately equal frequencies of each. Something between one-fifth and one-sixth of the total sample have dirty jobs.

When the March sample were asked about their television viewing habits, approximately twelve percent did not watch T.V. at all, and almost half watched more than twenty hours per week. Among the sampling areas, Morningside and Bellevue had relatively more in the one-to-nine hours bracket, and relatively less in the over-twenty hours grouping. Stenhouse and Leith have most people watching more than twenty hours per week.

## THE ANALYSIS OF RESPONSE FREQUENCIES

### Neighbourhood satisfaction

Ratings of satisfaction with the home area are present only in the March interviews and are based on a single question. (Question 2) Responses of "excellent" or "good" are grouped together as indicators of high contentment, while the remaining ratings, which imply some degree of criticism, are combined to give a "low-satisfaction" grouping. There is, apparently, no marked preference of either group for a particular definitional category, as combined in Table 9-22. There is, however, weak statistical significance (ten percent level) for a relationship in which low-satisfaction is linked with awareness of air pollution in the neighbourhood. (Table 9-23) This is in spite of the fact that satisfaction ratings varied to an appreciable degree from the norm in only two sample areas, Morningside and Bellevue. (Table 9-15) Since the latter, according to available monitoring data, is the second dirtiest of the interview sites, (Table 9-24) the observed inverse relationship between neighbourhood satisfaction and awareness of air pollution in the home area is unlikely to depend on actual differences in air quality among the sampling areas.



Although there was no apparent relationship between neighbourhood contentment and perceived "seriousness" of air pollution as an Edinburgh problem, (Tables 9-25 and 9-26) there was a highly significant inverse connection between neighbourhood satisfaction and perceived seriousness of neighbourhood air pollution. (Table 9-27 and Table 9-28) Unfortunately, this could not be verified in June data because the problem hierarchy questions were not repeated at that time. There was, however, an indication of consistency from the March data, in that the more satisfied group tended to give significantly higher ratings to neighbourhood air quality (Table 9-29) and to give more favourable comparisons of local air relative to that obtaining in Edinburgh generally. (Table 9-30) Only slight evidence was found to suggest that the high-satisfaction group were less "concerned" about air pollution, (Table 9-31) and there was no apparent connection between neighbourhood contentment and willingness to consider general taxation as a means of financing pollution control. (Table 9-32) Local satisfaction was, similarly, unrelated to views on the utility of pollution control. (Table 9-33)

Of the agree-disagree statements, only one, involving subjective assessment of recent pollution trends, was significantly related to neighbourhood satisfaction. (Table 9-35) This finding must be suspect since a corresponding pattern does not emerge in the distribution for the similar question 21(a). (Table 9-36) The remaining tables (9-37 to 9-41) are included for reference.

These data indicate that those less satisfied with their neighbourhood are more likely to note air pollution there, and to rate it as a "serious" local problem. Consistently, the satisfied respondents tend to rate local air quality in more positive terms. This result conflicts with the suggestion from chapter four that "those highly



satisfied with their neighbourhoods will be more concerned about air pollution".<sup>2</sup>

Responses to the March question "Are there some things you like about living in this part of the city?" are summarized in Table 9-42. The largest single grouping, "location", contains such answers as "handy to the shops", "easy to get out of the city", and "It's central". Comments on community spirit and friendly neighbours are combined under "people". Favourable remarks on shops form the third category. Some respondents simply said they liked the neighbourhood because they had always lived there or because their parents had lived in the area. These answers are coded under "sentiment". Mentions of job opportunities or lower cost of living in the area form a further grouping. "Clean air" contains such comments as "plenty of fresh air here", "bracing sea wind", and "It's a smokeless zone". Noise was mentioned by itself and in combination with traffic. "Other amenities" are mainly in praise of recreational opportunities such as parks, libraries, and swimming baths. Expressions of general aesthetic satisfaction with the area are also included here.

In June, this question was phrased, "What would you say are the principal advantages of living in this area?" Responses are categorized, as for March, in Table 9-43. In both cases only the first mentioned advantage is tabulated, although others were recorded. The overall pattern is changed little by summing all advantages mentioned.

Most respondents offer at least one advantage of their neighbourhood: 96.7 percent in March; 94.4 percent in June. On both

occasions, quietness has a greater response frequency than clean air. This may be somewhat deceptive, insofar as a number of respondents later define air pollution as noise. In March, 6.1 percent spontaneously mention clean air as a positive aspect of their neighbourhood, compared with 3.4 percent in June. Appreciative mentions of air quality occur mostly in areas remote from the city centre, such as Stenhouse and Portobello which have the highest frequencies and the cleanest air according to monitoring data. (Table 9-24)

Stenhouse was one of the first areas of Edinburgh to come under smoke control orders. (Map 6-1, Table 6-1) At this time, all grates in this Corporation housing estate were altered for smokeless fuel. It may be that this direct personal involvement in curbing smoke emissions augured for greater awareness of air pollution. A number of Stenhouse respondents indicated surprise at being asked about air pollution and replied almost indignantly, that this was a "smokeless zone". For some, the smokeless zone had the character of a talisman against air pollution.

Portobello, on the other hand, has strong impetus to awareness of pollution in the form of two obvious local sources, the Portobello Power Station chimney and the beaches. The former not only spreads the shadow of its plume over the whole area, but also deposits grit. This nuisance was a complaint particularly for a caravan sales operator who incurred increased operating costs in keeping his wares clean. It also affects the near-by Portobello Swimming Pool. The beaches, in warm calm weather, become a source of stench at low tide, as sewage from Seafield washes back to shore and there decays along with accumulated seaweed. Pollution from these sources is,

perhaps, more striking because of the contrasting clean air usually carried in from over the Firth of Forth and East Lothian.

Ratings of general satisfaction with the neighbourhood are cross-tabulated with specifically mentioned local advantages in Table 9-44. The ratings are dichotomized, as in earlier tables, with "excellent" and "good" being combined to form the "high" grouping. The relative proportion of respondents in each advantage category is approximately equal for each neighbourhood rating level.

Almost all mentions of clean air as a neighbourhood "like" come from Portobello and Stenhouse in March (nineteen out of twenty-one), and from Portobello in June (five out of six). The following group of tables focuses on these objectively (Table 9-24) and subjectively "clean air" areas in order to examine how the respondents who spontaneously mention air quality as a neighbourhood advantage answer subsequent, direct questions about air pollution. Because of the group size (nineteen), conclusions based on these tables are speculative.

When rating air pollution as a city problem (Table 9-45), approximately 40 percent of those mentioning "clean air" give "very serious" or "serious" ratings. In ranking air pollution against ten other city problems, about one-third place it in the top five. (Table 9-46) These percentage frequencies are not significantly different from the summary frequencies for all Portobello and Stenhouse respondents. As a neighbourhood problem, about ten percent give "very serious" or "serious" ratings. (Table 9-47) Twenty-one percent rank air pollution among the five, of the presented problems, which are "most serious" in their neighbourhood. (Table 9-48) Thus, on the basis of these data, spontaneous mention of air quality

as a positive neighbourhood factor is only slightly related to subsequent evaluations of air pollution as a local problem, and unrelated to its city priority.

There is a tendency for the "clean air" group to indicate higher "concern" for air pollution than does the total Portobello and Stenhouse sample. (Table 9-49) In these areas, such a large percentage of respondents rate local air "excellent" or "good" that the almost unanimously positive ratings given by the "clean air" group are not statistically meaningful, though expected. (Table 9-50) Those noting clean air as a neighbourhood advantage are, apparently, no more likely to give a high priority to television programmes on the subject. (Table 9-51) They are, however, more likely to be bothered by air pollution than the total Stenhouse and Portobello sample (Table 9-52) and to be slightly more willing to pay a tax for pollution control. (Table 9-53) They unanimously rate neighbourhood air as better than that existing in Edinburgh generally. (Table 9-54)

On the basis of Tables 9-45 to 9-54, there appears to be a tendency, though not marked, for those who volunteer clean air as an advantage of their area also to give air pollution a lower priority as a neighbourhood problem. As well, they tend to express greater concern about air pollution, and to be more bothered by it. This group is consistent in its positive evaluation of neighbourhood air, and tends to be more willing than the whole sample to pay for anti-pollution measures.

#### Conclusion

The main conclusion that may be drawn from this evidence on the relationship of neighbourhood satisfaction to interview answers is

that respondents who are highly satisfied with their neighbourhoods tend to be less aware than others of air pollution as a local phenomenon, and to de-emphasize it as a problem.

#### Neighbourhood disadvantages

Before there was any mention of air pollution in the interview, both samples were asked if they had any cause for discontent with their neighbourhoods. Any complaints about air pollution were, therefore, spontaneous, and not influenced by a desire to "give the right answer". The approximately one hundred different "dislikes" were reduced to seven categories in Tables 9-55 and 9-56.

"Services" includes, mainly, criticism of bus, shopping, and recreational facilities. "People" summarizes comments on vandalism, unpleasant neighbours, messy children, fouled pavements and entrances, and "rowdies". Responses mentioning murky or dirty air, smoke, sewage smell, and exhaust fumes are grouped under "Air pollution". The "Other physical disamenities" category contains comments on climate, topography, lack of garden space, and litter. "Others" includes criticism of employment opportunities, and statements of general dislike. Over both samples, about four percent of all respondents noted air pollution as a disadvantage of their neighbourhoods. The percentage was slightly more in March than June, but not sufficiently so to confirm a seasonal variation in concern.

The striking feature of Table 9-55 is that almost half of all respondents have no complaints about their neighbourhoods at all. The comparable fraction is one-third in June. One may speculate that for different respondents this feature may denote a defensive reaction born of neighbourhood loyalty, a certain guardedness in the

interview situation, or a genuine satisfaction with the home area. Residents of Central City and Leith are slightly more willing to criticise with "People" the most frequent specific complaint category in the former and "People" and "Air pollution" most mentioned in the latter. Morningside respondents note "Services" and "Traffic and Parking". The latter category also prompts most comments in Bellevue, while "Services" has the greatest frequency in Stenhouse and Portobello.

The spontaneous mention of air pollution as a neighbourhood disadvantage tends to occur with much greater frequency in the three "dirty" areas, Leith, Bellevue, and Central City, suggesting a congruence of "reality" with perception.

Dichotomized neighbourhood satisfaction ratings are cross-tabulated with dislikes in Table 9-57. There is a tendency for those giving the lower ratings of satisfaction to be more willing to criticise their neighbourhoods and specifically, more willing to mention air pollution as a nuisance.

In March, those spontaneously identifying air pollution as a local source of bother unanimously agree, in a later question, that air pollution is present in their neighbourhoods. (Table 9-58) However, Table 9-59 shows the kind of inconsistency that can arise in these data. Here, two respondents who mention the problem as a local "dislike", later deny its presence in their neighbourhood.

Since almost all those mentioning air pollution as a neighbourhood disadvantage came from Leith, Bellevue, or Central City, the following examination of responses will focus on those sampling areas. The cell frequencies involved are extremely small and any conclusions based upon them are, accordingly, tentative.



There is no apparent inter-relation between spontaneous mention of air pollution as a local "dislike", and rating of air pollution as an Edinburgh problem. (Table 9-60) When air pollution is ranked against other Edinburgh problems, there is a slight tendency for the "air pollution" group to give relatively more rankings in the top five. (Table 9-61) However, when these same problems were rated on the neighbourhood scale, there was a marked tendency for those who spontaneously mention air pollution to rate it also in the "serious" or "very serious" categories. (Table 9-62) This tendency is even more pronounced when the ranking of air pollution is used as an indicator of its "seriousness" as a neighbourhood problem. (Table 9-63) Those volunteering air pollution as a local nuisance are more likely than other respondents to give high ratings of concern for the problem. (Table 9-64) They are also more likely to rate neighbourhood air as "less than good" (Table 9-65); to be bothered by air pollution (Table 9-66); to be willing to pay a tax for pollution control (Table 9-67); and to compare local air unfavourably with city air. (Table 9-68) There is no apparent connection between ascribed priority of a television programme on air pollution and spontaneous mention of the problem as a neighbourhood nuisance. (Table 9-69)

#### Conclusion

Those aware of air pollution as a local nuisance and those finding clean air a positive attribute of their neighbourhood both are consistent in their responses to other questions on the interview. Their responses are also consistent with monitored pollution data, insofar as appreciative comments come from the cleaner areas



of Portobello and Stenhouse, and criticism from the dirtier areas of Leith, Central City, and Bellevue. Both those appreciative and those critical of local air quality show a heightened awareness of air pollution and a greater concern about it than do the rest of the sample. They are more likely to be bothered, and to be willing to support a pollution tax. Those noting air quality as a local advantage are consistent in de-emphasizing the problem in their neighbourhoods. Conversely, those criticising local air later emphasize air pollution as a local problem.

#### Problem hierarchies

Before air pollution was announced as the subject of the interview, respondents were asked to rate the "seriousness" of a number of problems mentioned in the local press over the previous year. The procedure involved the respondents in sorting cards, each of which named a problem, on to a base sheet which had squares labelled "very serious", "serious", "not serious", "not a problem", and "don't know". If more than one card was placed in the "serious" or "very serious" boxes, respondents were asked to rank these. The initial instructions were to sort the cards "thinking of the city as a whole". In question six, this was changed to "thinking of this neighbourhood". The combined percentage of "very serious" and "serious" ratings is shown in the middle of each cell of Tables 9-70 and 9-71.

On the city scale, traffic, unemployment, and vandalism are major concerns. The relatively high column average for sewage disposal (thirty-three percent) derives mainly from Portobello (sixty-three percent) and Morningside (forty-two percent). The former is easily understood in terms of local nuisance due to smell from accumulated matter on the beaches. The latter may result from

heated exchanges over the health effects of the city sewage disposal system then raging in the Letters to the Editor columns of The Scotsman. This paper is taken by many more respondents in Morningside than in other sampling areas. (Table 9-72) Drug-taking is rated "very serious" in slightly more cases than air pollution, alcoholism, loss of historical buildings, noise, and smoking. All of the latter group receive about the same level of concern. Contagious diseases defines the lower end of the problem scale (three percent).

This hierarchy depends on the problems selected for inclusion, and on the degree to which their names were meaningful. A "free-response" question, a different problem list, or different problem names, could result in a markedly different hierarchy.

The shift in focus from city to neighbourhood was, apparently, successful. Loss of historic buildings is a local problem of note mainly in the Central City, and not at all in Stenhouse, Portobello, and Morningside. It is somewhat surprising that recent attention to the preservation of New Town Edinburgh did not prompt more "very serious" ratings in Bellevue. Perhaps, that problem is felt to be in hand. Only in Portobello does sewage disposal have a high frequency of "very serious" ratings. Sewage which has left an area is, apparently, no longer considered to be its problem.

Residents of Morningside and Bellevue tend to rather conservative ratings on both scales. There also appears to be a tendency for these areas to project their satisfaction with their neighbourhoods to the city as a whole. Stenhouse respondents apparently differentiate rather sharply between their situation and that of the rest of the city. These same three, Morningside, Bellevue and Stenhouse, most frequently rate their neighbourhoods "excellent" places to live. (Table 9-73)

On the local scale, vandalism stands out for Stenhouse; sewage disposal and vandalism for Portobello; traffic for Morningside; unemployment for Leith; traffic for Bellevue; and traffic and unemployment for Central City. For specific problems there is a decreased frequency of "very serious" ratings from city to neighbourhood scale. Traffic, unemployment, vandalism, alcoholism, and drug use all follow this pattern. These are problems usually associated with one part of the city, frequently the city centre, or, in the case of unemployment, areas of declining industry, such as Leith. Air pollution, noise, and smoking hold approximately the same frequency at both scales.

Stenhouse and Morningside respondents suggest that the air in their sections is better than in the rest of the city. The Central City and Leith samples indicate that the local problem is worse. Portobello and Bellevue give approximately equal numbers of "very serious" ratings to air pollution at each scale. Later in the interview, those aware of air pollution in their local area at any time were asked to compare air quality in the city with that in their neighbourhood. (Table 9-74) Most Stenhouse respondents denied that air pollution ever existed there. Of those aware of air pollution in Stenhouse, all rated local air better than that in the city generally. Morningside also shows a tendency to give strongly positive ratings to local air. Central City and Leith have most "worse" ratings, with Bellevue also showing a tendency toward negative ratings of local air. Despite their rating of air pollution as a "serious" neighbourhood problem, the Portobello sample, apparently, feel they have better air than the rest of the city. These responses are largely consistent with the problem

hierarchies and show a correspondence with monitored pollution levels, which increase from Stenhouse through Central City. (Table 9-24) There is, in contrast, a tendency for those living in Stenhouse and Portobello, the "clean" areas, to give more frequent "very serious" ratings to air pollution than those from the "dirty" Bellevue and Central City sections. (Table 9-70) This could be interpreted as evidence that those living with relatively heavy pollution become inured to it, while those having more intermittent exposure accord it higher priority.

### Conclusion

Overall, there is agreement between neighbourhood problem priority ratings and monitored pollution levels, with the exception of Portobello with its peculiar local problems. There is also a suggestion that intermittent exposure to local pollution tends for higher priority ratings for air pollution as a city problem. Over the total sample, Edinburgh's ranking of eighth for air pollution among the suggested city problems indicates the lowest priority of any urban population where similar information has been collected.<sup>3</sup> (Table 4-4)

### Definitions

Air pollution was identified as the main focus of the interview with the question: "Would you tell me, in as much detail as you can, what the term air pollution means to you?" The term had already been introduced in the problem hierarchy section, and had, presumably, been the object of some thought during the card-sorting process. The meanings ascribed are basic to subsequent responses,

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and constitute the most direct statement in the data of the subjective significance of this concept.

A first "definitional model" has given apparently worthwhile results in Crowe's Johnstown study, (Table 4-2), where he found that "the types of definitions given to air pollution varied significantly by educational level, social position, (and) the perceived existence of air pollution in the local neighbourhood".<sup>4</sup> Crowe's definitional categories were used in Figure 9-1:

"Causal", those naming a source (e.g. industries, autos, power station);

"Effectual", those noting results (e.g. smuts on clothes, paint deterioration, dirty windows);

"Specifics", mentions of particular contaminants without a vector of cause or effect;

"Combinational", which involve a grouping of the other categories (e.g. "Smuts from the school ruin my wash".)

These categories account for approximately eighty-eight percent of the total Edinburgh responses, with percentage results reasonably constant from March to June. (Figure 9-2) A large proportion define in combinations, usually in the form of a particular effect and its suspected cause. Relatively few base their meanings solely on a causal agent or specific contaminant. As would be expected, effects loom large in their own right and as part of "combinations".

Detailed comparison with Crowe's findings are frustrated by his non-numerical reporting, and by the nature of the categories

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4. CROWE, M.J. 1968.  
Toward a "definitional model" of public perceptions of air pollution.  
J.A.P.C.A. 18 (3), 154-157. P.157.

themselves. Any increased emphasis on probing from one study to another would convert large numbers of "specifics" into "combinatorials", and Crowe does not comment on the kind of probes he used. Similarly, interviewer variations in probing techniques could make a nonsense of any aggregation of such data, unless the number of interviewers employed was large enough to cancel these effects. Some effort was made to avoid this problem in Edinburgh by supplying probes on the schedule, and by instructing interviewers to use only neutral probes. <sup>5</sup>

Joint frequency distributions were prepared for March and June data showing definitional categories by age, sex, length of residence, occupation, social class, awareness of air pollution in the home area, and education. In no case were these relationships statistically significant at even the ten percent level. However, tendencies for those with higher education to define in combinations and for those aware of air pollution in their neighbourhood to define in specific terms were observable, though not marked. The latter effect was more distinct when recognition of an air pollution problem rather than air pollution occurrence, was used as the index of awareness. (Table 9-75)

Crowe's model had the advantages of separating effects from simple definitions. It did not, however, distinguish between smell and dustfall as sources, nor did it allow assessment of whether sources of bad smell were more or less likely than grit to be associated with a specific emitter. The categories employed in Tables 9-76 and 9-77 are an attempt to overcome these difficulties, yet to retain the advantages of Crowe's scheme.



"Fumes" seemed, from the responses, to be used as a synonym for smell, and so these were grouped in one category which included smoky smell, gas fumes, petrol vapour, among others. When these were linked with a source, as in traffic fumes, brewery smell, or fumes from oil central heating, the response was considered to be more complex and was given a separate grouping. The same approach was followed with the "smoke, soot, dust, dirt, film" categories. Effects mentioned alone included poor visibility, rubber perishing, and paint blackening. Some of the sources noted without any elaboration were: furnaces lighting up; stagnant water; factories. A number of responses did not fit this grouping scheme and were brought together as "Others", for example: lack of oxygen; sulphur in the air; "varies with the season".

Among the sampling areas, Leith tends to definitions involving dustfall rather than smell in a ratio of two to one (eighteen vs. nine). Portobello has an equal number of definitions of each type (eighteen). Portobello and Leith frequencies accord well with what is known of local sources, in that the former has the beaches as an occasional source of smell, particularly in summer, and the Portobello Power Station as a source of grit; the latter has with Leith docks, Scottish Agricultural Industries, and mills nearby.

These two tables suggest that about five percent of the sample had no communicable idea of what constituted air pollution. At the other extreme about thirty-five percent were able to give a source and name some effect. In both samples a larger proportion thought of air pollution in terms of smell rather than dustfall.<sup>6</sup> It is a striking feature of both tables that definitions in terms of

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6. March: 31% vs. 26%; June: 36% vs. 25%



smell are very much more likely to be accompanied by a named source than are definitions in terms of dustfall.

### The presence of air pollution

#### Direct questioning

Responses to the question, "Would you say there is air pollution in this part of Edinburgh at any time?" are tabulated as an index of awareness for each sampling area in Tables 9-78 and 9-79. The most striking feature of these distributions is that well over forty percent, in both March and June, deny the presence of air pollution in their neighbourhoods at any time. This is difficult to reconcile with smoke and sulphur dioxide data which indicate relatively heavy concentrations of pollutants over the whole city on at least some days of every year. This suggests that some respondents do not notice, or have a high tolerance to, things in the air. Alternatively, these responses may indicate an unwillingness to attribute a "pollution" situation, with all the negative connotations of that word, to one's home area. A similar "neighbourhood halo" effect has been found in other studies, but its cause remains a matter of debate. <sup>7</sup>

#### Subjective versus objective awareness

The Edinburgh sampling areas are arranged in Table 9-78, a rough progression of average winter pollution, from Stenhouse, the cleanest, to Central City, the dirtiest. (Table 9-24) It appears that the average winter monthly concentrations of smoke and sulphur dioxide, used here as indicators of "real" pollution levels, correspond well with awareness of pollution, as expressed in the interviews. The three June sampling areas represent a lessened pollution

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7. Pp. 4-41 to 4-42 and P.4-27.

contrast because the cleanest section, Stenhouse, was omitted. This may explain why the March relationship is not repeated in the June data. (Table 9-79) Nonetheless, because of the strong significance of the March distribution, and the explanation for the June disagreement, it seems reasonable to interpret these tables as evidence for a congruence of perception with "reality".

#### Bother and complaint

The March interview asked about "bother" attributed to air pollution, and about attitudes toward complaining. The seven questions involved were addressed only to those who were aware of air pollution in their home area (i.e. "Yes" to question 12(a)). In response to the first of these, "Have you, personally, ever felt bothered by air pollution?", approximately fifty-seven percent gave affirmative answers, (Table 9-80) i.e. twenty-nine percent of the total sample.

The ratio of those bothered by air pollution to those aware of it is higher in Stenhouse, Portobello, and Morningside (about two-thirds) than in Leith, Bellevue, and Central City (about one-half). To this extent, air pollution could be said to be a greater bother in the relatively cleaner areas.

A number of cross-tabulations were undertaken to see if bother varied with sample characteristics. (Tables 9-82 through 9-87) There was a tendency for high education respondents to be more bothered. Class, sex, and use of tobacco were apparently unrelated, nor was the experience of having "lived more than one year" in another city or in the country. The strongest relationship was with age, in that after thirty, bother from air pollution decreased in both

relative and absolute terms with increasing years.

There was a tendency for those less satisfied with their home area to be more bothered by air pollution. (Table 9-88) As might be expected, the "bothered" respondents were more likely to give low ratings to neighbourhood air quality, (Table 9-89) and to give high ratings to the "seriousness" of local air pollution. (Table 9-90)

The March question number twenty-one was intended as a check on response consistency. The bothered group were expected to agree that air pollution had increased in recent years (Table 9-91) that it constituted a health threat (Tables 9-92, 9-93, 9-94) and that more action was needed on air pollution control. (Table 9-95) They were expected to deny that air pollution was "a fact of life" (Table 9-96), "an unavoidable part of industry" (Table 9-97), and that air quality had improved in recent years. (Table 9-98) In all cases these relationships were observable, and in most instances with statistical significance.

It may be that respondents are simply taking a position on the interview subject and keeping their answers consistent. But, the interview was relatively long (about 30 minutes) and there was little time for pondering each answer, particularly in the true-false type questions. Also, there was no penalty or reward involved for the respondent, beyond, perhaps, the desire to obtain the interviewer's regard. It seems unlikely that the observed response consistency is contrived. More likely is that those inconvenienced by air pollution constitute, by virtue of that experience, a group with a characteristic response pattern.

Of the group who were bothered, slightly more than half felt like complaining about it, (Table 9-99) constituting approximately

seventeen percent of the total sample. Only in Bellevue was there an appreciable excess of potential complainers. Over the three "dirty" areas, Leith, Bellevue, and Central City, there was only a slightly increased tendency to consider complaint.

The distribution of those saying they had actually complained (Table 9-100) is striking for its relatively constant ratio of complainers to non-complainers over the sampling areas. Of these nineteen complaints only five would have a chance of being recorded in a government office. (Table 9-101) In this sample, about one quarter of those who consider complaining actually do. Of those, only one quarter are recorded. This confirms the findings of earlier studies,<sup>8</sup> and reinforces the conclusion that analyses of complaints records are based on only the tip of the iceberg.

Those who did not complain, but indicated that they felt like doing so, were asked to whom they would have directed their comments. All but eleven percent of this group had some idea of where to complain. (Table 9-102) Although no conclusion may be drawn on such a small proportion of the total sample, the table does suggest that, for this group at least, air pollution is held to be a government responsibility. Fully twenty-seven, of the thirty-seven answers, mention some government official. By contrast, the offending source is noted as a likely complaint recipient only twice. Even when actual complaints are added in, government is still the main focus by thirty-two to nine. Few people, apparently, consider a letter to the editor a useful form of complaint on this matter.

When asked why they had not complained the most frequent answer involved unexpressed personal reasons: "I just didn't"; "I'm not the complaining type". (Table 9-103) Others felt their complaint

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8. Ibid. Pp. 4-43 to 4-45.

would have had no effect, or did not know where to complain.

Those bothered by air pollution were asked, "What in particular bothered you?" The question, unfortunately, contained an ambiguity which is reflected in the responses. (Table 9-104) More than half focused on the annoying effect that they had experienced, while forty-one percent identified the offending source, or kind of source. Comments on health effects ranged from the general, "It's bad for your health", to one description of a baby almost choking on fumes from Scottish Agricultural Industries at Leith. References to bad smells were grouped as "disamenity". The "dirt" category received mentions of dust or smuts on washing and windows or cars getting dirty too fast.

#### Conclusion

These tables on bother and complaint indicate:

- a) That about one-quarter of the sample are bothered by air pollution;
- b) That as age increases the proportion noting air pollution as a nuisance decreases;
- c) That bother is related to low neighbourhood satisfaction, low ratings of neighbourhood air quality, and high ratings of the seriousness of local pollution;
- d) That only about one-sixteenth of those who consider making a complaint actually do complain to a record-keeping agency.

#### Health and air pollution

Those aware of pollution in their neighbourhoods were asked, "Do you think air pollution has any harmful effects on human health?"

Even allowing for the leading nature of the question, the ninety-seven percent "yes" response is impressive, and is consistent with proportions obtained in other studies. (Table 4-5) When the Edinburgh respondents were asked what health effects they had in mind, one hundred and fifty-three, of the one hundred and seventy-two, mentioned some respiratory illnesses. The almost unanimous agreement of Edinburgh respondents that air pollution harms health overwhelms possible relationships with other variables. There is, however, a good deal less response unanimity when personal health effects are the focus.

Those giving affirmative answers to the general health effects question were asked, "Do you feel that air pollution is a threat to your health personally?" The summary of these responses, by sampling area (Table 9-105) indicates no consistent relationship with monitored pollution level, which increases, though not in equal steps, from Stenhouse to Central City. (Table 9-24)

What is striking is the proportion denying any personal health effect of air pollution. This "not me" reaction has been explained in other contexts as an expression of personal invulnerability or of "masking". In the former, one agrees to the presence of danger, but denies that it will happen "to me". In the latter, a potentially worrisome situation is hidden or put aside to avoid its overt recognition and the implications which that recognition would carry for action, or anxiety.

The latter effect could arise from feelings of inability to influence the air pollution to which one is exposed. Table 9-106 does indicate a slight tendency for those denying personal health effects to rate air pollution as an intractable problem. Although this distribution is not statistically significant, two others

dealing with efficacy of action are. (Tables 9-107 and 9-108)

These tables show that respondents who perceive a personal health risk arising from exposure to air pollution are less likely to accept poor air quality as an "unavoidable part of industry" or as a "fact of life".

Awareness of a personal health threat from air pollution was examined for relationship with socio-economic variables. (Tables 9-109 to 9-113) Of these only age showed a statistically significant distribution, with increasing years associated with denial of health risk. Consistently, those who felt that their health was threatened by air pollution tended to express greater concern about a general pollution problem. (Table 9-114)

If the latter relationship is part of a preoccupation with personal health generally, it would be expected also in responses to other potentially threatening phenomena. Therefore, ratings of contagious diseases as an Edinburgh problem were cross-tabulated with perceived personal health risk. (Table 9-115) It appears that those concerned for health damage due to air pollution are no more likely than others to worry about contagious diseases. Similarly, there was no relationship between ratings of contagious diseases as a problem and ratings of concern for air pollution. (Table 9-116) As a final check, self ratings of health status were cross-tabulated with awareness of health risk due to air pollution. Table 9-117 shows that those in poorer health are more likely to note a health threat from the air they breathe. This has two interpretations: that hypochondriacs are more likely to worry about air pollution; or, if the health ratings are accurate, that those in poor physical condition are more aware of a threat. One would expect that ratings



of poor health, if accurate, would increase with age. This does occur in Table 9-118, yet awareness of personal health threat decreases with age. (Table 9-113) It seems, therefore, that awareness of possible health damage from air pollution is related, in some degree, to the respondents' health, rather than to age as such.

Respondents who gave a low personal health rating, and who were aware of a health threat from air pollution, were distributed more or less uniformly throughout the sample. (Table 9-119) Although the numbers involved were extremely small, the relationship of health status and awareness of a pollution threat appeared to be independent of air quality in the home area.

As might be expected, respondents who are concerned about possible damage to their health from air pollution tend to be more critical of their neighbourhood air quality, (Table 9-120) and to take the expected choices on response consistency checks. (Tables 9-121 and 9-122)

In rating and ranking air pollution, first as an Edinburgh problem, then as a neighbourhood problem, respondents concerned about health effects were more likely to attribute high priority to air pollution. (Tables 9-123 to 9-126) There is an apparent, strong connection between concern for air pollution generally and concern for its impact on personal health.

Other indices of concern were employed, including the respondent's personal priority rating of a television programme dealing with air pollution. This rating was found to relate closely to the respondent's awareness of a health threat from air pollution. (Table 9-127) A later question asked about willingness to pay a "yearly personal tax" of one pound to achieve air pollution control. Again, responses

were related to perceived health risk, but only slightly. (Table 9-128) The health threat groups were also more likely to be bothered by pollution. (Table 9-129)

#### Conclusion

These tables, investigating the linkage between health and responses to questions about air pollution, bear the following conclusions:

- a) Air pollution is linked with adverse effects on human health when such a connection is suggested in the interview, but only nineteen out of the total of 540 who were interviewed mentioned health effects spontaneously in defining air pollution;
- b) There is a marked tendency to deny personal health effects from air pollution;
- c) Those noting a personal health threat are likely to indicate greater interest and concern about air pollution on other questions;
- d) Respondents who are in poor health are more likely to be aware of a threat to their health from air pollution;
- e) Older members of the sample are more likely to deny health effects.

#### Adjustments to air pollution

Responses to the hypothetical question "When air pollution is particularly bad what can a person do?" are summarized in Figure 9-2. The most frequent response grouping "personal air filter" includes such answers as "wear a smog mask", "keep mouth closed", "cover the mouth", and "install air conditioning". Suggestions

to call a doctor, police, M.P. or "authorities" were grouped under "complain". "Put up with it" subsumes such comments as "not much one can do"; "wait for it to pass"; "let nature take its course". Suggestions to switch to smokeless fuel, refrain from burning rubbish, or restrict vehicle use were categorized as "stop individual smoke emission".

These responses may be assessed according to their active/passive; withdrawal/attack potential. The principal reaction is apparently withdrawal, either passively in waiting it out, or actively in trying to limit effects. Some do advocate action, directly by limiting pollution created, or indirectly via complaints and petitions. Overall, there appears to be little recognition of individual contributions to the problem; few people link their own bonfire or car exhaust to air pollution. When March respondents were asked whether they "believed" the air pollution situation in their neighbourhood could be improved most answered in the affirmative (Figure 9-3) indicating strong positive attitudes towards human capacity to control and even eliminate air pollution.

Since there have been no publically identified air pollution episodes involving immediate loss of life in Edinburgh, the proportion of "don't know" and "no response" may indicate that the adjustments required by the question are so unfamiliar that many respondents have difficulty in treating them, even hypothetically. This lack of undeniable pollution effects may also explain why few respondents mentioned the Alkali Inspectorate or the Public Health Department as having responsibility for air pollution control, insofar as they have never been forced to call upon these agencies. Alternatively, the studied "low profile" of these departments may be a factor.

These possible explanations again raise the question of causal balance between the physical presence of pollution and information about the subject in producing awareness.

It appears that respondents in the relatively cleaner Portobello area (Table 9-24) are less willing to consider adjustments. (Table 9-130) The two exceptions are the suggestions involving leaving the city, either temporarily or by making a permanent move. Portobello is on the edge of Edinburgh, and its residents may thus be more accustomed to getting away from the city. Also, it is tempting to conclude that people in higher pollution areas will be more familiar with "very bad" air pollution, and hence be more willing to entertain the idea of adjustments. If this were the case, one would expect residents of the dirtiest area, Central City, to have more positive attitudes toward adjustments than those in the intermediate area, Leith. That this does not occur, greatly, weakens the conclusion that Central City's willingness to consider adjustments is in some way a function of pollution present.

The question itself may be criticised insofar as it is easy to agree to activities that are already part of one's life. For example, those living in centrally heated flats could, painlessly, do without coal fires. Or, non-smokers and those without cars could easily assent to give these up. Although doubtful as an index of intended behaviour, the responses do seem to suggest attitudes: there is a greater tendency to keep children indoors than to stay indoors oneself; a complaint to a Member of Parliament is seen as more relevant than a letter to the editor. An approximate hierarchy of adjustments does seem to emerge with "close windows", "wear a smog mask", and "avoid doing a washing" considered

to be the most reasonable possibilities. Coal fires and burning rubbish are also easily associated with "very bad" air pollution.

#### Conclusion

In general, the respondents thought of adjustments to severe pollution in terms of limiting effects upon themselves and their families. They believed the problem itself could be solved, but not by their own action. A hierarchy of feasible adjustments existed in which restraint on personal use of car or tobacco held low position.

#### Responsibility and effort on pollution control

Responsibility ratings were obtained from the card sorting questions.<sup>9</sup> Predictably, in view of the attitudes to adjustments described above, individual citizens were assigned small responsibility and effort regarding air pollution control. (Figures 9-4 and 9-5) However, the low responsibility assigned to the gas and electricity boards was less expected insofar as the Portobello Power Station chimney, located within one sampling area, is a conspicuous landmark and was frequently mentioned in another part of the interview as a specific, bothersome source, and Granton Gas Works, until recently one of the largest single coal users in Edinburgh, has prompted frequent smell complaints over the years.

Most respondents accord major responsibility for air pollution control to local and national governments with whose efforts they are, essentially, satisfied. Implicit in this response trend is the assumption that effective control must be collective, and that government is in the best position to carry forward such a programme.

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9. Questions 15(a) and 15(b).

Costs of air pollution

About thirty percent of the June sample felt that air pollution affected them financially in some way. Responses categorized under "Damage to materials" included stone deterioration, paint blackening, and metal corrosion. (Figure 9-7) Increased cleaning costs were mentioned by an equal number, while health effects were noted less frequently. Rather less than ten percent felt that the financial sanction of air pollution came through taxation.

Seasonality of awareness

The March interview sought to establish whether those respondents aware of air pollution in their home area were also conscious of seasonal variation in pollution levels. To this end they were asked, "Have you noticed air pollution to be worse in any particular season?" Responses, tabulated in Table 9-131, show a modal frequency for "winter", followed by "all about the same" and "summer".

A number of factors seem relevant to the identification of winter as the prime pollution season. Since the Beaver Report,<sup>10</sup> it has become a commonplace that British air pollution problems are strongly related to domestic coal consumption for space heating. The persisting British tradition of open grate coal fires results in a multiplicity of low-level smoke emissions which are frequently carried to the ground where they become all too obvious to the senses, particularly during cold, calm conditions. Outdoor activities are not severely disturbed by British winters so that opportunities to observe pollution would not be much diminished in that season. It

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10. Committee on Air Pollution (Beaver Committee).  
Final report.  
London. H.M.S.O. November, 1954.

should also be noted that the persistence of continuous low cloud cover, the relatively short days and resultant lack of convective mixing in Britain in winter could all contribute to oppressive conditions with which one could easily associate air pollution.

Two other factors seem relevant for Edinburgh. Many respondents define air pollution in terms of smells, principally from motor vehicles and sewage. Although these unmonitored sources would peak in summer, both would be, to some extent, present all year round. Other pollution levels, particularly of the more observable "smoke" (Figure 9-7) peak in winter when visibility too is poorest. <sup>11</sup>

#### Conclusion

The distribution of responses in Table 9-131 seems to parallel the seasonality of "actual" pollution in Edinburgh: most in winter; some all year round; some principally in summer.

#### Cognitive dissonance

Festinger's "theory" of cognitive dissonance has been suggested by Creer <sup>12</sup> as germane to perception of air pollution. According to this general hypothesis people were unable to tolerate prolonged inconsistency between their actions, on the one hand, and their knowledge and beliefs on the other. Such inconsistency was thought to produce psychological stress leading to selective distortion of

11. CROSBIE, A.J., CROSBIE, N.J., and DICK, J.H.A.  
Air pollution in Edinburgh. Part I. Ms. 1968. Pp. 17-26.
12. CREER, R.N., GRAY, R.M. and TRESHOW, M. 1970.  
Differential response to air pollution as an environmental health problem.  
J.A.P.C.A. 20 (12), 814-818.



various aspects of the stressful situation to make it conform with the pre-existing attitudes. In terms of air pollution, it was hypothesized that, relative to other members of a sample, workers in polluting industries would de-emphasize air pollution as a problem, and would over-emphasize the employers' pollution-control efforts.

To test this hypothesis the Edinburgh samples were divided according to employment in "dirty" or "clean" jobs. Criteria for inclusion in the former category were:

- a) likely exposure to air pollution in the work environment;
- b) employment in an industry that visibly contributes to local pollution.

Others were considered to work in clean jobs.

If either "dirtyjob" standard was satisfied by the respondent's present or pre-retirement employ, the category requirement was fulfilled. Included in this group were employees of foundries (at Musselburgh), S.A.I., I.C.I., the Leith mills, as well as demolition and coal workers. There were slightly more men than women in this group. (Tables 9-132 and 9-133) Since the class assessment was based on occupational social status, it was to be expected that a predominance of "dirtyjob" respondents would be assigned to the "low" category. (Tables 9-134 and 9-135) This group was not significantly different from the rest of the sample regarding length of residence in Edinburgh or age. They were, however, more likely to have lower educational ranking (Tables 9-136 and 9-137), to be renters rather than owners, (Tables 9-138 and 9-139) and to spend fewer days away from Edinburgh each year than other sample members. (Table 9-140).

According to the hypothesis, a higher proportion of workers in a polluting industry would be expected to deny the effects of air pollution on their health. Although there is a tendency toward this relationship in Tables 9-141 and 9-142, neither distribution has statistical significance and it would be wrong to interpret these as confirming the hypothesis.

Edinburgh responses on "seriousness" of air pollution (Tables 9-143 and 9-144), and the relative position of air pollution in neighbourhood and city problem hierarchies (Tables 9-145 and 9-146) all show a tendency for the dirtyjob group to attribute less importance to air pollution than do other respondents. A question dealing directly with "concern" elicited the same response trend. (Table 9-147) Again, none of these distributions carried statistical significance.

In considering "willingness to pay a pollution control tax" as an indicator of concern, it must be remembered that many of the dirtyjob group have small incomes, and thus may be more daunted by the suggested tax. Whether this is the prime influence or whether these respondents are consistently carrying through a low priority for air pollution is not clear. Table 9-148 does show a significant tendency for the dirtyjob group to reject the suggested levy.

On the basis of the hypothesis, the dirtyjob group would be expected to be more positive than others in their evaluation of the effort made by industry to control air pollution. Yet, Tables 9-149 to 9-153 suggest, in their row percentages, the reverse of this effect.

#### Conclusion

These tables show that cognitive dissonance effects are not a major influence on interview responses. The hypothesized tendency

for those in dirty jobs to de-emphasize air pollution as a problem is observable, but there is no trend indicating positive attitudes, for this group, toward industry's efforts at air pollution control.

#### Socio-economic variables

##### Age

Divisions for age are set at thirty-one, forty-six and sixty-five. The first and last of these are familiar break-points, frequently associated with changes of attitude and life style. Forty-six was a convenient intermediate stage, allowing four divisions, and thus, the possibility of observing systematic changes in response frequencies with age.

In both March (Table 9-154) and June (Table 9-155), there is a significant tendency for the two younger groups to be more aware of air pollution in their neighbourhoods than are the over forty-fives. Throughout both distributions, relative percentages of "yes" responses decrease consistently with increasing age, indicating the strong possibility of an inverse relationship between age and awareness of air pollution.

Rating and ranking of air pollution as a city problem are not significantly related to age. (Tables 9-156 and 9-157) On the neighbourhood scale, there is, however, a tendency for the older half of the distributions (Tables 9-158 and 9-159) to give a lower priority to neighbourhood air pollution. This may be a reflection of the decreased awareness with age shown in Tables 9-154 and 9-155, or because the effect operates on neighbourhood and not city scale, it may result from a heightened sense of neighbourhood loyalty with increasing age. The latter explanation is unlikely, however, since ratings of neighbourhood satisfaction are, apparently, not related

to age. (Table 9-160)

Satisfaction with neighbourhood air quality does increase markedly with age in the March sample, (Table 9-161) in a consistent trend through the four age levels which carries an extremely high statistical significance. ( $> 0.1\%$ ) The same tendency, and also highly significant, is seen in the age distribution of comparisons between neighbourhood and city air quality. (Table 9-162)

The majority in all age groups assign low general concern about air pollution. There is, however, a tendency for the oldest respondents to give a disproportionate number of "low" concern ratings. (Table 9-168) As a further indicator of concern, respondents were asked if they would be willing to pay a tax for air pollution control. In the March data, there is a significant tendency for the two younger groups to be more willing to pay the tax than are their elders, (Table 9-164) with a marked change occurring between the middle two age groups.

March respondents were asked if they thought the air pollution in their neighbourhood could be lessened. As age increases, so too does the relative frequency of conservative responses. (Table 9-165) A similar trend may be seen in Table 9-166, where responses to question 21(b) are presented, by age category. The relative percentage of respondents agreeing that air pollution is "a fact of life" increases consistently with age. Responses to the statement, "Air pollution is a necessary part of industry", show the same relationship. (Table 9-167) In both cases, it is the oldest age group who strongly influence the significance of the distribution.

These tables (154 to 167) provide strong evidence for a relationship between age and awareness of air pollution. On the

neighbourhood scale, the two older groups tend to give air pollution lower problem priority and to be more satisfied with local air quality. The oldest group are less concerned about air pollution and more likely to agree that air pollution is a "fact of life" and a "necessary part of industry". Willingness to pay tax for pollution control decreases with age, as does belief in the effectiveness of action, of any kind, in reducing air pollution.

There are a number of factors which may contribute to an explanation of the observed response changes with age. First, sensory acuity declines markedly with advanced age. Respondents, particularly in the over-sixty-five group, may, in fact, sense less air pollution and so be less aware and concerned about it. This effect would, logically operate in younger age groups among smokers, who are, presumably, accustomed to acrid stench and particle-choked environments. The latter possibility will be investigated in a later section. Second, some older people may take a shorter time perspective, and be unwilling to support an effort that would be of small personal benefit. Third, environmental values change. The older group formed their standards of "tolerable" pollution during the exigencies of war, depression, and a second war. These, understandably, are different from the rising expectations of younger people who have joined the labour force in easier and more prosperous times, often with the benefit of increased formal education. Fourth, receptivity to new ideas, reputedly, decreases with age; new environmental standards, and new research knowledge, will not only be more readily accessible to the younger through their increased schooling, but also they will be more open to it. Fifth, young people have discovered protest. They have seen how vociferous demonstrations, by

even a small group, can generate enthusiasm in others and achieve action otherwise unattainable. They may, therefore, see more point in expressing criticism of their environment.

### Sex

There is a significant tendency, in March data, for males to be more aware of air pollution in their neighbourhoods. (Table 9-168) The same relationship, though not statistically significant, is suggested for June by the relative percentages in Table 9-169. Despite this, the assessment of air pollution as an Edinburgh problem is not significantly associated with the sex of the respondent. (Tables 9-170 and 9-171) On the neighbourhood scale, however, there is a slight trend for males to give more "serious" ratings, (Table 9-172) which, when rankings are considered, (Table 9-173) becomes significant at the ten percent level.

Neighbourhood satisfaction does not vary with sex in these data, (Table 9-174) but there is a tendency for favourable neighbourhood air quality ratings to be made more frequently by females. (Table 9-175) No significant connection is observed between sex and comparisons of local with city-wide air quality. (Table 9-176) There is, however, a slight tendency for males to give high concern ratings, (Table 9-177) a trend not observable in another concern index, the willingness to pay for pollution control. (Table 9-178)

On the above evidence, there is no strong relationship between questionnaire answers and the respondents' sex. There is, however, some suggestion that males are more aware of air pollution in their neighbourhood.

### Education

It was hypothesized that education would be a key factor in both awareness and concern regarding air pollution because understanding of the components of the problem, such as damaging effects on health and materials, transport of pollutants, and control possibilities, depend on learned concepts. Many of these are directly presented in formal studies, particularly in the physical and biological sciences. Study in the social sciences could produce heightened awareness of pollution as a social problem and of the inter-group dynamics involved. A complicating factor is that a decreasing proportion of highly educated respondents obtains for each age increment, (Tables 9-179 and 9-180) reflecting the increasing availability of post-secondary education during the life span involved. Respondents with post-secondary training form the "high education" group; others are classified as "low".

In March, recognition of air pollution as a neighbourhood condition was strongly related to educational level. (Table 9-181) This tendency for the highly educated to be more aware of air pollution is also discernable for June responses, but is not statistically significant; (Table 9-182) a lack of corroboration which undermines confidence in the March finding.

Problem hierarchies, on both neighbourhood and city scales are dichotomized in joint frequency distributions with education in Tables 9-183 through 9-186. There is a significant tendency, in these data, for the low education group to give low ratings on the "seriousness" of air pollution as a city problem and to give also low priority rankings vis-a-vis other Edinburgh problems. This inverse relationship of education to perceived seriousness and



problem priority of air pollution is repeated for the neighbourhood scale, though much weakened. Despite this relationship, the more educated respondents did not indicate higher concern about air pollution, (Table 9-187) a finding which emphasizes the critical influence of question wording and form.

In a further query on neighbourhood air quality, significantly more high education respondents gave critical ratings. (Table 9-188) There was, however, no observed educational difference in comparisons of neighbourhood with Edinburgh air quality. (Table 9-189)

June respondents showed a tendency, though not statistically significant, for a direct relationship of educational level with awareness of personal costs imposed by air pollution. (Table 9-190) Stated willingness to pay a small annual tax for pollution control showed the same direction of relationship, this time with high significance. (Table 9-191)

These tables (9-181 to 9-189) suggest that educational level relates directly to:

- a) awareness of air pollution in the home area;
- b) priority of air pollution in problem hierarchies at the city scale;
- c) unfavourable evaluation of local air quality;
- d) willingness to consider general taxation as a means of financing pollution controls.

#### Class

Occupational social class was assigned according to the categories in Appendix 1. Missing cases arise <sup>13</sup> because some respondents had no occupation or were living on private incomes or social benefits.

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13. June: 9; March: 13.

These could have been assigned a class rating on the basis of the assessment in the interviewer's report; but, in general, the latter estimates did not correspond well with assigned occupational status, where both pieces of information were available.

Upper class respondents, in Table 9-192, are almost twice as likely to notice air pollution in their neighbourhoods, in spite of the location of over half the group <sup>14</sup> in the three "cleaner" sample areas. (Table 9-193) The middle class group are also more likely to note the presence of air pollution, but the difference in percentage frequency is less marked. The lower class, on the other hand, reverse the trend, and are more likely not to recognise air pollution in their neighbourhood, despite the majority of this group living in the three "dirtier" areas. <sup>15</sup> These patterns are repeated in June. (Tables 9-194 and 9-195)

The two indicators of concern employed in March show a pronounced, and significant, class variation in response. The lower class have a greater frequency of low concern ratings in Table 9-196, and are less forthcoming about a proposed pollution control tax, (Table 9-197) an effect that may follow from lower incomes in the lower occupational social class, and resultant need for tighter controls on spending for any purpose. (Table 9-198)

These data show a strong tendency for awareness of air pollution in the home areas, and concern about the problem, to increase with occupational social status. Faith in the validity of this finding is weakened by the lack of interconnection between occupational social class, as defined here, and problem ratings and rankings. No

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14. 24 out of 41.

15. 71 versus 60.

evidence is found for a relationship between job status and attitudes toward air pollution controls, or concern regarding possible health effects due to pollution.

#### Use of tobacco

A set of cross-tabulations were prepared comparing interview responses by smokers and non-smokers on the same range of variables used with other socio-economic attributes in the sections above. In no case was a consistent or statistically significant relationship observed. It must be concluded that a respondent's use of tobacco is no indicator of his expressed views regarding air pollution.

#### Tenure

It is hypothesized that ownership of property might well influence attitudes toward air pollution, particularly regarding potential damage to materials, such as paint blackening, screens rusting, and stone flaking. In the following section, owners and tenants form separate groups wherein ownership refers to residence only, and does not take account of possible property ownership by domestic tenants for business or investment purposes.

There is no evidence in Tables 9-199 and 9-200 to support the contention that owners are more concerned about effects of air pollution. In fact, over both samples, slightly more tenants define in terms of effects alone,<sup>16</sup> and slightly more owners in terms of the sensory annoyance of smells and fumes.<sup>17</sup> There is no consistent relationship of tenure and definition, at least as the latter is categorized in these tables.

March data shows a statistically strong tendency for owners

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16. 15 versus 18.

17. 92 versus 83.

to be more aware of air pollution in their neighbourhoods. (Table 9-204) This partial confirmation of the hypothesis is all but destroyed by the comparable June table (9-202), which shows no evidence whatever for such an interconnection.

Problem ratings based on the semantic scale of "seriousness" show no relationship with tenure for either the city (Table 9-203) or the neighbourhood. (Table 9-204) When respondents were asked to give their "serious" and "very serious" problems a priority ranking, a tendency for owners to rank air pollution more highly occurred, at both scales. (Tables 9-205 and 9-206) Since this connection has strong statistical significance only at the neighbourhood scale, it must be treated as tentative.

In these data tenure was not related to subjective air quality ratings; attributed concern about air pollution; nor to willingness to support a small tax for pollution control. (Tables 9-207 to 9-209) It is particularly telling that owners in the June sample were no more likely to think air pollution cost money than were tenants. (Table 9-210)

On the basis of these tables, the case for any relationship between attitudes toward air pollution and tenure remains unproven, and seems doubtful.

#### Conclusion

This examination of response variation with the socio-economic characteristics of the sample suggests a number of relationships summarized here in order of their increasing strength:

- a) Tenure is a doubtful index to other questionnaire responses;
- b) There is weak evidence, based on answers to a single question, that males are more aware of local pollution than are females;

- c) High occupational social class is directly related to heightened awareness and concern regarding air pollution;
- d) A similar direct relationship obtains for educational level;
- e) Age is inversely associated with awareness and salience of air pollution in these samples.

#### Response to smoke control areas

In both sets of interviews an attempt was made to test opinion about the operation of the Clean Air Acts. In a very "open" question March respondents identified "smokeless zones" as a recent attempt at pollution control. (Figure 9-8) In addition, substantial numbers noted that government possessed, or had exercised, responsibility in this matter, and mentioned a general increase in the use of smokeless fuels. Clearly, these people had some knowledge of recent efforts, with the smokeless zone concept coming to mind most readily.

In a more directed query, the June sample were asked whether smokeless zones were "the best way to fight air pollution". Seventy-five percent were convinced that they were, with the remainder split evenly between negative and uncertain responses. The favourable attitude toward smoke control suggested here was confirmed by answers to the probe, "Why is that?" (Figure 9-9) Here, many of the negative assessments of smokeless zones were revealed as criticisms of government failure to extend the concept sufficiently into industrial and heavy traffic sectors. Thus, more than three quarters of the sample held positive feelings about the idea of smoke control areas.

#### Information sources

One aim of the March interview was to find how respondents got

information about air pollution. It was hypothesized that the more sources there were for information on this subject, the more likely an individual was to be aware of and concerned about air pollution.

#### The "info" score

An "information index" was constructed on the basis of fifteen items from the March interview. The first of these asked, "Do you recall hearing about air pollution in any of these ways: newspapers, television, radio, magazines, doctor, local government, friend or relative?" A yes response to any part was given one mark on the index, for a maximum of seven. Question ten, on television priority, was worth one mark if the respondent indicated that he would make special arrangements to watch a programme on air pollution or would watch it in preference to offerings on other channels. An additional mark was given for the experience of having lived "in the country", or "in another city", for a possible total of two marks on question twenty-five. If respondents spent any number of days outside Edinburgh during the past year, (question 26) they were given one point. One point was also assigned for membership in the public library (question 28), taking a newspaper (question 29), and watching television (question 30). Actual scores ranged from one to thirteen, with fifteen being the maximum possible. In order to provide sufficient numbers in each cell of the planned joint frequency distributions, it was necessary to group these scores. Aggregate scores of one to five formed a "low-information" group, six and seven were the lower-middle, eight and nine the upper-middle, and ten and over comprised the "most informed" category. In the following tables these appear with numerical designations 1 to 4 respectively.

Information scores tend to vary directly with social class.

(Table 9-211) As might be expected there is a significant tendency for the over-sixty-five age group to have fewer information sources than other age categories, (Table 9-212) and for educational level to show a strong, direct relationship with information score. (Table 9-213) Property owners tend to be disproportionately represented in the highest information category (Table 9-214), as are males.

(Table 9-215) Those with "dirty jobs" occur with higher proportionate frequency in the low information grouping, and much less often in the high information category. (Table 9-216) There is no significant relationship between neighbourhood satisfaction, or length of residence in the city and scores on the information index. (Tables 9-217 and 9-218) Although Table 9-219 shows a significant connection between smoking and information scores, the relationship reverses within the distribution and must be regarded as suspect. 2

In summary, membership in the top information category is most frequently associated, in the March sample, with upper class and high education, current employment in a "clean" job and home ownership. It is unfortunate that these questions could not be repeated for validation in June because of the length of that interview.

In order to test the hypothesis that awareness and concern regarding air pollution would increase with information score, a number of joint frequency distributions were prepared. In the statistically significant Table 9-220, large "info" scores were associated with an increased awareness of the presence of air pollution in the neighbourhood. The high information group were also more critical of neighbourhood air quality, both in their ratings (Table 9-221), and in their comparisons of local with Edinburgh air,



(Table 9-222) while those bothered by air pollution were much more likely to come from the top two information categories, than from the others. (Table 9-223)

Air pollution receives higher problem hierarchy positions, on both local and city-wide scales, from the top two information categories. (Tables 9-224 to 9-227) Consistently, these categories also indicate a greater willingness to consider a pollution control tax, (Table 9-228) although this distribution does not carry the high statistical significance associated with many of the others in this series.

A high info score was apparently associated with positive attitudes toward pollution control and a rejection of a passive response to pollution. When asked how much they felt the air pollution in their neighbourhoods could be reduced, the two highest information groups were more likely to suggest that action on air pollution control would be highly efficacious, (Table 9-229) and to reject the view that air pollution was a "fact of life", or a "necessary part of industry". (Tables 9-230 and 9-231)

In summary, the information index has been shown to reflect certain attributes of the respondent; including occupational social class, age, education, tenure, and air pollution exposure in the job situation. The index was found to be significantly related (at the five percent level or above) to awareness of air pollution in the neighbourhood, rating of neighbourhood air quality, "bother" by air pollution, and ratings of air pollution as a problem.

#### Relative power of information sources

Although the data presented in Table 9-232 derives from a multi-part question with a repetitive format, it may give some indication

of the relative frequency with which the various sources are associated with information about air pollution. Faith in the validity of this data is increased by the increased "yes" frequency for the final category, "friend or relative"; if the decreasing affirmative response rate had been solely an indication of boredom with the question structure this up turn would not have occurred.

Impersonal information sources have the greatest frequency, with newspapers and television equal firsts, followed at some distance by radio and magazines. Only then does the personal source, "friend or relative" take its place, widely separated from the other direct-contact categories, "doctor" and "someone in local government". On this basis, impersonal sources would seem to be most readily associated with information about air pollution.

To investigate whether the use characteristics of the particular source affected the info score, newspaper purchases and television viewing habits were scrutinized in more detail.

Newspapers were ranked in a subjective hierarchy, in Table 9-233, to test whether info scores varied directly with the "quality" of the newspaper. The Evening News, being a local paper, was given a separate category, as were special interest publications such as the Morning Star and religious and labour union papers. The "Top" group included The Times, The Guardian, The Glasgow Herald, The Financial Times, and The Scotsman. The Daily Telegraph occupied the "Upper-middle" classification, The Daily Mail and The Scottish Daily Express, the "Lower-middle". The News of the World, The Daily Record, and The Daily Mirror were assigned "Bottom".

The observed connection between low info scores and "low quality" papers requires further investigation, and may have bearing upon the

mode of future presentation of reports about environmental quality in order to gain their maximum possible effect.

There is a suggestion, in Table 9-234, that low information access regarding air pollution relates to low preference for news, public affairs, and documentary programmes on television. Adventure and drama offer more promising vehicles for altering environmental attitudes among those currently least informed.

## CONCLUSIONS

It is now possible to summarize the Edinburgh findings on the hypotheses outlined in chapter seven. Broad areas of agreement between this case study and those reported in chapter four may identify stable and widely occurring response patterns. Conversely, local response peculiarities may suggest regional or temporal influences. Conclusions are presented here in the same order as the discussion of the frequency tables.

### Neighbourhood satisfaction

The hypotheses involved with this variable a) linked high neighbourhood satisfaction with high saliency of air pollution as a local problem; and b) suggested that air pollution was not often mentioned spontaneously as a local problem. <sup>18</sup>

The former must be rejected for Edinburgh where respondents indicating contentment with the local area consistently denied the presence and importance of air pollution as a neighbourhood concern. The latter, however, is supported insofar as only twenty-two, of a possible 540, mentioned air quality as a disadvantage of their home area.

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18. P.4-37 and 4-38.

### Problem hierarchies

On the basis of Table 4-4 it was hypothesized that air pollution would be a "serious" problem for Edinburgh respondents too. However, the overall ranking of eighth among the city concerns presented called this assertion into question. It was indeed striking that this was the lowest ranking of any city where similar data had been obtained.

### Definitions

Former studies suggested that "air pollution" was a well-developed concept which most respondents defined with little difficulty. This contention was upheld in the Edinburgh samples where only about five percent were unable to give a meaning for the term and approximately thirty-five percent provided complex definitions.

### Recognition of air pollution

Three statements were tested with regard to awareness of air pollution:

- a) People notice air pollution;
- b) Opinions about air quality agree, substantially, with monitored pollution information;
- c) More people are aware of air pollution in summer.

Since forty percent of Edinburgh respondents denied the presence of air pollution in their neighbourhoods, the first hypothesis is in some doubt. There was, however, evidence of a direct relationship between average winter smoke and  $\text{SO}_2$  levels and awareness expressed in interviews. A similar "reality"/perception congruence was observed with monthly monitoring data, wherein winter was identified as the season of worst pollution. The final hypothesis was thus rejected for Edinburgh.

Bother and complaint

Former studies had found that annoyance with air pollution and complaint to a record-keeping agency were not linked in a simple way.<sup>19</sup> It was therefore not surprising to find that only about one-sixteenth of the ninety Edinburgh respondents who considered making a complaint actually followed through with it.

Health and air pollution

The hypotheses involving health effects of pollution are:

- a) Respondents are willing to agree that air pollution harms health, but this connection is seldom volunteered in the definition;
- b) There is a reluctance to apply the general effect on health to oneself.<sup>20</sup>

Each of these were upheld in the Edinburgh data.

Adjustments to air pollution

The basic supposition involved here was that people were aware of the options available to them in dealing with severe pollution. In general, this was confirmed, although a marked tendency to consider only adjustments that would limit effects on self and family was displayed. There were few suggestions to control personal contributions to the problem.

Responsibility and effort on pollution control

This area had been identified in earlier investigations as primarily a government sphere of action,<sup>21</sup> an impression confirmed

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19. Pp. 4-43 to 4-45.

20. Pp. 4-45 to 4-46.

21. Pp. 4-49 to 4-50.

by Edinburgh respondents, who were essentially satisfied with control efforts to date. Remaining problems were, in their view, to be solved by extending existing policies to new sources, rather than by radical changes.

#### Cognitive dissonance

The cognitive dissonance hypothesis was specified here as: Those exposed to high pollution levels in their work environments will tend to deny the adverse effects of air pollution, and to hold strongly positive views on industry's control efforts. Although such an effect was discernible in certain distributions, it was not a major factor in response patterns, and would seem to require study at a smaller scale, such as an isolated, individual factory.

#### Socio-economic variables

Of the socio-economic variables that were hypothesized to be related to responses regarding air pollution, age showed the strongest relationship, varying inversely with both awareness and saliency of the concept. Social status and educational attainment varied directly with awareness and concern, but not with the strength of the age relationship.

#### Information sources

From the modification of natural hazards theory, undertaken in chapter seven, it was hypothesized that the higher the quantity of information sources a respondent had the more likely he was to be informed and concerned about air pollution. The index score was found to be strongly related to interview responses in a way suggesting that it functioned to some extent as a surrogate of education and social class. Nonetheless this somewhat crude attempt

has identified an important parameter that should be included in any future study of this type.

#### Regional effects on response variation

On the basis of past studies and of the Edinburgh analysis it appears that recognition of air pollution has a component of regional variation which flows from the twin sources of a) the local emission and climatic context; and b) the limitations of human sensory capacities. For example, where outdoor activity is not severely disrupted by winter weather, as in Southern California and the U.K., and where the pollutants are obvious to the senses, as eye-stinging smog and acrid coal smoke, perceptions of air pollution have been found to accord well with the actual situation. The distribution of learning effects, that links, for instance, perishing rubber, stunted plant growth and flaking stone with air pollution, may function as an overlay modifying the pattern of directly and naively perceived pollution. From such learning about effects expectancies arise which themselves colour and to some extent distort awareness.

#### General response patterns

Across this range of research which spans perhaps two decades and a wide variety of cultural, natural, and emission settings, there are certain consistent response patterns. Notable among these is the reluctance to attribute a recognized general health threat from pollution to one's person. Explanations for this, and for the almost as ubiquitous "neighbourhood halo" effect, range from the operation of psychological defence mechanisms to the possibility that they may be artifacts of the interview situation itself.



Equally unexplained, yet widely observed, is the relationship of "bother" with complaint, wherein only a fraction (one-sixteenth in Edinburgh) of apparently equally annoyed respondents will complain formally about air pollution. Thus a multiplier must be employed if analyses of complaints records are to be extrapolated; also, the likely limitations on the complaint range must be recognized.

Human response to air pollution, unlike that to other "natural hazards", is related to certain socio-economic variables, notably age, educational level and social class; the latter two in a direct variation with awareness and saliency, the former in an inverse relationship.

One of the difficulties with the preceeding analysis is that it frequently seeks to establish relationships between "hard" and "soft" data, for example between age and "seriousness" ratings of the pollution problem. As pointed out above, soft data involves a range of possible answers for each individual, and is therefore more susceptible to variation due to bias in the interview procedure. Variability in soft data is to some extent offset by aggregation, with the assumption that error responses will cancel each other. Another possibility is to "spread the weight" over a number of variables by identifying patterns in the interview answers. One technique for accomplishing this is factor analysis, which is employed in the following chapter.

## Chapter 10

### FACTORS IN QUESTIONNAIRE RESPONSES

#### Objectives

It has been suggested that the increasing availability of information about environmental problems in the news media has been a "major force contributing to the growth of public awareness and concern".<sup>1</sup> If this were the case, information-related variables would be expected to show a strong accounting on the first factor in this type of analysis.

Factor analysis offered the possibility of locating and identifying the relative importance of respondent characteristics in explaining variance in interview answers. Further, it was anticipated that if such attributes were identified, the relationships involved would confirm the conclusions already reached on the basis of frequency distributions. (Chapter 9)

Factor analysis also held promise for questionnaire development. It could, potentially, identify redundant items and hence allow a future study more economical data collection.

Its capacity to incorporate a large number of variables raised the possibility that novel hypotheses might be suggested. These could subsequently be tested with Junedata, data from other existing studies, or in future investigations of this type. By inspecting which variables contributed to each factor, it might also be possible to hypothesize macro relationships transcending the individual

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1. AULICIEMS, A. and BURTON, I.  
Perception and awareness of air pollution in Toronto.  
Toronto. Natural Hazards Research. Working Paper No. 13.  
1970. Pp. 17-18.

variables. For instance, information sources and pollution exposure might emerge as strongly related to response variation. If such overarching relationships did emerge, conceptualization and hypothesis formation in future studies could be carried on at a more general level, possibly with new variables becoming obviously relevant.

#### WHAT FACTOR ANALYSIS DOES

Factor analysis is a modelling procedure in which mathematical techniques are used to achieve data reduction. A square correlation matrix of variables is reduced to a rectangular matrix of variables and factors. The advantage is that the number of factors is usually much less than the number of variables, yet the factors, by identifying common characteristics among the data, carry a large proportion of the original information. Therefore, large numbers of variables may be economically managed.

Factor analysis is limited by the relevance of the selected data. Ideally, all parameters affecting the subject would be incorporated in the analysis. The process can only identify patterns of relationship among the variables with which it is provided. Input variables need not, however, be of equal validity, reliability, or comparability in the sense that interview responses to specific questions, such as age, education and sex may be included along with answers expressing opinion. Although the variables included may be qualitative or quantitative, the latter must be expressed numerically and with reference to some scale, even though its intervals may be unequal. Factor analysis is concerned with structural interconnections or clusters within the data and is therefore absolutely dependent upon the range and relevance of that data. This is especially true because, in interpretation of results, it is assumed that observed correlations

and factor loadings indicate meaningful relationships and are not merely chance occurrences.

A standard factor analysis was used <sup>2</sup> employing the orthogonal rotation varimax, which seeks to minimize the number of factors on which a variable has loadings. Factors are derived by linear combination of the original variables in the correlation matrix. These factors, or dimensions, may be conceived as patterns of vector points in n-dimensional space. The clusters are defined by their "loadings", which are the projection of each vector point on the factor axes, and represent the correlation between the factor and the variable. If individual factor loadings are squared they give the proportion of variation that is explained by that factor for that particular variable. Oblique rotation was not undertaken as it involved severe interpretational problems.

Although the following discussion is focused on common variance, that is upon the proportion of total variance that is patterned, it should be emphasized that this is not the same as total variance, which is greater and involves the sum of both common and unique variance in each variable. The factors having eigenvalues (i.e. the sum of the square of the factor's loadings on all variables) greater than one are considered to delineate common variance.

Factor analysis, as used here, does not include tests of statistical significance; rather, it is used to provide a different perspective on the data. Although the technique itself is well known in geographical literature, <sup>3</sup> the author is not aware of its previous

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2. NIE, N., BENT, D., HULL, C.  
Statistical package for the social sciences.  
London. McGraw-Hill Book Co. 1970. P.20.

application to this type of interview information. Accordingly, this analysis is to some extent exploratory in nature.

#### RUN 1

The thirty-five variables involved in the first factor analysis (Table 10-1) represent questions that were asked of all 360 respondents in March, 1971. (Appendix four) There were no missing data, as "don't knows" and "no responses" were coded for this analysis.

Correlations between the variables were generally low, (Table 10-2) ranging downward from 0.54 on a Pearson product-moment correlation. Some of the relationships having co-efficients in the band 0.25 to 0.54 were between: the various information sources (question nine); the various problem ratings and rankings (questions five and six); or involved educational level, age, or monitored pollution levels in the home area. These coefficients, marked by a dot in the table, suggest partially overlapping or redundant items. Their relatively low level indicates that no single dominant variable that is represented in these data, accounts for the responses given. The large number of moderately low correlations tends to validate the underlying assumption in the construction of this questionnaire, i.e. that a large number of influences contribute to the "perception of air pollution". The low correlations also suggest that the findings of the factor analysis will not be definitive in that a high number of factors will be required to account for the observed variance.

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3. E.g.:  
 BERRY, B.J.L. 1961.  
 A method for deriving multi-factor uniform regions.  
 Przegląd Geograficzny 23 (2), 263-279.  
 Reprinted in The Bobbs-Merrill Reprint Series in Geography.  
 G-13.

On the basis of the factor analysis, twelve factors were found to account for fifty-nine percent of all variation in the data.

(Table 10-3) When the unrotated factors are ordered according to the proportion of total variance for which they account, the largest single factor accounts for about twelve percent. (Table 10-4) Each factor delineates a pattern which is uncorrelated with the preceeding factors in the table.

The final communality values (Table 10-5) represent the proportion of a variable's total variation that is common to the set. They are valuable in themselves as they indicate the proportion of the variable that could, on average, be predicted on the basis of the other data. In decreasing order, greatest communality values are attached to age, rating of air pollution as a problem, occupational social status, newspaper as an information source, experience of living in another city, and monitored levels of air pollution in the home area. These, then, are the individual variables, of those selected, most powerful in accounting for response variation.

In the rotated factor matrix, factor one "explains" 11.8 percent of total variance and 26.4 percent of common variance. Its principal loadings concentrate on the problem ratings and rankings, local air quality ratings, the presence of air pollution in the neighbourhood, and ratings of concern about air pollution. Each could be interpreted as some dimension of "problem awareness" or "problem concern".

Factor two, which delineates 15.5 percent of common variance focuses mainly on information sources from which the respondent has "heard about" air pollution. The strength of this pattern derives from a multiple question, following a single format, and with the parts administered sequentially. (Question nine) None of the other

hypothesized sources of information on air pollution have a high loading on this factor, e.g. experience of living in another city, or in the country; number of days spent away from Edinburgh in the last year; method of travel in the city. For these reasons it seems prudent to suspect this factor as arising more from the format of the question than from a real variation in responses according to information sources.

Factor three, with 12.3 percent of common variance, has its main loading on age and age-related variables, but not on education, as might be expected. Most respondents with growing children will be in the lower age range, hence the inverse relationship between this factor and number of children in the household is not surprising. Similarly, as age increases so too does the likelihood of "poor" health ratings and the occurrence of other household members over sixty-five years of age. The only variable which is not obviously age-related and which has a loading greater than 0.25 is the rating of local air quality. (Question eleven) Its negative loading on factor three corroborates the earlier finding (Chapter 9) that as age increases so too does satisfaction with local air quality. The negative loading arises from the nominal scoring scheme adopted for question eleven, wherein ratings indicating high satisfaction received low scoring numbers.

Factor four, with 9.8 percent of common variance, has its principal loading on "city travel". This is a dichotomized variable, in which all means of transport where exposure to air is maximized, (e.g. bicycle, walking, motorcycle, scooter) were coded one, and others two. In addition, this factor appears to embody a "class" element involving house ownership, high occupational social status, a relatively large



number of days spent outside the city each year, and high educational level. For each constituent of this hypothesized element the direction of the loading is consistent for the scoring schema employed. The moderate positive loading of health rating is difficult to construe as other than a third, and weaker strain in the factor.

Factor five, representing 7.5 percent of common variance, is another "information" dimension. Its largest loading is on the average number of hours spent watching television each week. An inverse relationship of this factor with educational level and with priority accorded a programme on air pollution are indicated, as is a tendency to deny television as a source of information on air pollution. There are, apparently, more smokers than non-smokers involved in this "anti-information" factor.

The five dimensions summarized above account for 71.5 percent of common variance. The remaining factors have rapidly decreasing power and indeed, are getting so small that they may well represent specific influences rather than truly common factors. They nonetheless merit some consideration.

Factor six loads on "experience of living in another city" or "in the country", for more than one year. This could be termed a "past experience" factor. Number seven has highest loadings on the information sources that were omitted in the first information factor, number two. This apparently identifies personal contact information sources, doctor, friend, someone in government. Factor eight relates most strongly to monitored pollution levels in the home and work neighbourhoods. Factor nine loads most heavily on "class". This variable is based on a classification of occupational social status, (Appendix one) and has its high values scored as low numbers,

hence some loadings will be negative. Similarly, in the "INOUT" variable (twenty-two), indoor jobs are coded one, with degrees of outdoor work having higher numbers. In the main, outdoor jobs received low social status ratings. This factor might meaningfully be named "occupational class". Factor ten derives its strength from the respondents who spend a good deal of time outside Edinburgh each year, live in low air pollution areas, and do not think that air pollution ever occurs in their neighbourhoods. Factor eleven chiefly involves the number of old people in the home. Number twelve reflects another dimension of "problem concern" noted above as factor one.

#### RUN 2

The second factor analysis run was based on the interviews of the 177 respondents who were aware of air pollution in their neighbourhoods and had therefore been asked additional questions<sup>4</sup> pertaining to their views about that problem. Variables included in the analysis, and the questions from which they arise, are presented in Table 10-8. There is one composite variable, "INFO", which includes items that were hypothesized to indicate sources of information about air pollution.<sup>5</sup>

Correlations between the variables range downward from 0.68, (Table 10-9) and are, once again rather low. Age and neighbourhood air quality rating are the two variables most correlated with others (coefficients 0.25 to 0.68). Frequently, the various problem ratings and rankings show correlation; however, since the rankings derive,

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4. 12(b) through 21.

5. Details of the construction of this index are given on page 9-48.

in part, from the semantic rating scale, this would be expected. Educational level, "INFO", and comparison of neighbourhood with Edinburgh air quality also show interconnection with at least two other variables.

Exactly the same procedures were followed as in the initial run described above. Factors were derived from the correlation coefficients. Fourteen of these had eigenvalues greater than one, and accounted for 64.1 percent of the total variance in the data. (Table 10-10) The unrotated matrix for these "inferred" factors is presented in Table 10-11.

Final communality calculations above 0.65 are obtained for: comparison of neighbourhood with Edinburgh air quality (0.85); rating and ranking of air pollution as a neighbourhood problem (0.70 and 0.73, respectively); assessment of pollution hazard (0.71); rating of government effort on pollution control (0.68); age (0.69); and education (0.68).

Expectedly, dimensions of problem awareness come out more strongly, as does educational level, for this more "pollution aware" group. It is, however, striking that info does not show a stronger communality, particularly in view of Auliciems and Burton's hypothesis. Age maintains approximately the same communality as in Run 1.

The fourteen main factors from Table 10-10 are redefined in Table 10-13 in terms of their percentage of common variance. The first six of these, having new eigenvalues greater than one, account for 67.7 percent of the shared variation in the data. Loadings for these factors on each variable are presented in Table 10-14.

Factor one has its main loadings on the problem hierarchy variables, three to six, with local air rating (thirty-one), and concern

about air pollution as a problem (thirty-six) also involved. For each of these variables, the sign of the factor loading is consistent with their being systematically related to response variation. The first factor, which "explains" 21.6 percent of common variance, appears very similar to factor one of the initial run, "problem concern".

Factor two, with 13.6 percent of common variance, has its principal loading on age. The negative loading on number of children in the home (nineteen), and positive loading on the number of over-sixty-fives in the home (twenty) are both obviously age-related, as noted above in comment on factor three of the initial run. The lesser loadings (seven, eight, seventeen) indicate a connection between this factor and a tendency to reject air pollution as a threat to personal health (seven), as a "bother" (seventeen), and to refuse to consider personal taxation as a means to pollution control (eight). Consistently, high values on this factor relate to high ratings of local air quality (thirty-one). Factor two identifies the age-related tendency to reject any personal impact of air pollution, and may be termed an "age rejection" factor.

Factor three has a strong negative loading on education (thirty-seven), i.e. as the respondent's educational level increases, this factor decreases. The factor also has loadings that indicate low occupational social class (twenty-seven), employment in a "dirty" job (fourteen), a large number of hours per week spent watching television (twenty-eight), general dissatisfaction with the neighbourhood, (two) and low information index score (thirty-nine). In short, this factor is composed of a number of negative socio-economic elements.

The variable most heavily loaded on factor four is twenty-five, the comparison of neighbourhood air quality with that of Edinburgh generally. The monitored pollution level in the home area (thirty-eight) and rating of neighbourhood air quality (thirty-one) also have correlations of 0.66 and 0.30, respectively, with this dimension. Factor four indicates an agreement between monitored and subjectively assessed pollution levels. Since the two closely agree in their loadings, this may be designated a "pollution level" factor.

Factor five presents a picture of "acceptance and low-information". Here, air pollution is "a fact of life" (ten), a "necessary part of industry" (thirty-four), and no "bother" (seventeen). Information index scores are low (thirty-nine) and there is no knowledge of "recent steps" aimed at controlling air pollution (eighteen). Local air quality is seen in positive terms vis a vis that of the city generally (twenty-five).

In Factor six, which is in some respects the opposite of five, air pollution is a "major hazard" (eleven) that has "increased significantly in recent years" (nine). It is a serious problem (three) and government is not making enough effort at its control (twenty-one). This "aroused and dissatisfied" factor accounts for 5.9 percent of common variance.

Factors seven through fourteen delineate rapidly decreasing proportions of common variance and have eigenvalues less than one. (Table 10-12) They are, therefore, of less significance. Factor seven loads almost equally on the need for "more action" on pollution control (thirteen) and awareness of a "health threat" from pollution exposure (thirty-three). This dimension is suspect because almost all respondents shared these views.

Most of the variation accounted for by factor eight derives from variables thirty and thirty-five. The former reflects air pollution as a hazard, the latter indicates smokers. Since this factor has only five percent of common variance, it would be straining the evidence to suggest a relationship between smoking habits and perception of air pollution as a hazard.

Factor nine defines a dimension in which great efforts are seen to be made on pollution control (twenty-one and twenty-two), and concern for the problem is seen to be high (thirty-six). This "optimism" factor accounts for 4.7 percent of common variance.

The principal loading on factor ten is health rating (twenty-nine). Rather low coefficients are given for age (thirty-two), and perceived effects of air pollution on personal health. The directions of loading suggest that this factor is associated with old age, poor health, and denial of air pollution effects. It accounts for 4.1 percent of common variance.

In number eleven, "government" is accorded high responsibility for air pollution control (twenty-three) and its efforts to limit pollution are seen in strongly positive terms (twenty-one). This "satisfaction" factor has 3.9 percent of common variance.

Factor twelve is a low "class" (twenty-seven) and "renter" (one) dimension in which the individual citizen's responsibility for air pollution is minimized (twenty-four) and his efforts at control are seen in maximal terms (twenty-two). It could be designated as "tenure", but it has socio-economic overtones and hints at a "lower class" mentality or outlook on the problem. It is not, however, by any means a major factor, delineating only 3.4 percent of common variance.

Factor thirteen is associated with an indoor job (sixteen), a pessimistic view of recent air quality trends (twelve), and a high evaluation of the citizen's individual responsibility for limiting pollution. It accounts for only 2.9 percent of common variance.

Factor fourteen involves high monitored pollution levels in the work area and a rejection of air pollution as a city problem. It would be of more support for a cognitive dissonance effect if the dirty job variable also loaded on this dimension. As it is, this least important factor delineates 2.7 percent of common variance.

#### CONCLUSIONS

Because of the low correlations among variables, and the resulting low factor loadings, little of a definitive nature can be said on the basis of these factor analysis runs. At best, they may be treated within the context of the other information in this study as suggestive of influences on response variation. Therefore, findings are tentative.

However, on the basis of the two factor runs there appears to be some evidence for a connection among problem priority, awareness, air rating, and concern. If air pollution is admitted as a neighbourhood problem it must, ipso facto, be present and local air must have a low quality rating. If one calls something a problem one is constrained thereby to admit concern also. All this gives no indication whether recognition or concern comes first. The interplay of direct and indirect experience in attitude formation apparently occurs at a more subtle level than is reached by these interview items. There is, for instance, no interrelation of the "problem/concern" factors with information sources, or with "objective" pollution level indicators for the work and home areas.



Information sources do seem to have some importance in explaining response variation. Factors three and five in run one both have strong loadings on information-oriented variables. The first of these may over-emphasize the influence because of the number of closely similar question items included. In the second run, factor three seems similar to factor five in run one, although the former accounts for a higher proportion of common variance. The information index apparently reduces the "specific question type" effect suspected of influencing factor two in run one. For this reason run two may well give a clearer picture of the relationship of information sources to response variance.

From this analysis, however, the information sources specified in the study are not found to have such a major relationship to awareness and concern as might have been expected on the basis of Auliciems' and Burton's hypothesis. This is particularly the case in the second run where those not aware of air pollution in their neighbourhoods were excluded. If the hypothesis were to be upheld info would have been expected to show a higher communality here. It is also possible that the information sources used in this study were inadequate and that a future investigation should seek to incorporate variables based upon: extent and character of specialist training; content analysis of reading materials; television and radio use habits; and to evaluate in more detail the effect of social ties on responses.

Among the socio-economic attributes included, age is the most powerful in explaining response variation over both runs. This finding, together with that of the frequency table analysis,<sup>6</sup> suggests

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6. Pp. 9-38 to 9-41.

that age is more influential in the Edinburgh sample than in other studies of this type, <sup>7</sup> and raises a question about the relative age compositions of the different populations involved in these studies.

Factor analysis has implication for questionnaire development in that items having low communality could be omitted in a revised schedule, thus permitting almost as much information to be collected with a much reduced expenditure<sup>of</sup> time and effort. If the March interview were to be revised on the basis of this analysis, possible variables for exclusion would be:

- a) air pollution exposure in the work area (question 23);
- b) whether job is indoors or outdoors (question 23);
- c) work location (question 23);
- d) willingness to pay a pollution control tax (question 20);
- e) perceived efficacy of action on pollution control (question 19);
- f) home area rating (question 2);
- g) experience of living in "the country" (question 25);
- h) personal health rating (question 33);
- i) use of tobacco (question 35);
- j) number of old people and young children in the household (question 32).

If this were, in fact, to be undertaken a useful first step would be to re-run the factor analysis with these variables omitted to see if the observed patterns remained.

On the question of the comparison of "reality" and "perception", factor four of run two suggests some degree of agreement. Monitored

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pollution levels share this pattern with neighbourhood air ratings and comparison of neighbourhood and Edinburgh air quality. This is the only major factor to involve monitored pollution levels, suggesting that influences other than objectively present pollution are powerful in explaining the variation in responses to the relatively wide range of questions employed. It should be remembered that the "reality" measurement used here is confined to data from 24-hour smoke and SO<sub>2</sub> machines and does not include any information on smell.

It seems significant that the problem ratings, which were most powerful in both factor runs, were part of an hierarchy in which air pollution was positioned relative to a fairly comprehensive list of other problems. This question comes closest to the real-life situation wherein variously limited resources of personal concern are allocated among competing problems. The ethos in which the person is operating is, to a limited extent, involved in this question type. It may be that a study of the "perception of air pollution" per se is not possible. Rather, attitudes to pollution, and other concerns, must be evaluated against the background of the prevalent spirit and common sense in that spatial and temporal context. However, the principal conclusion of this analysis must be that human response to air pollution, in Edinburgh at least, involves a complex of influences in which no one variable or set of related variables has paramount importance.

## Chapter 11

### THE PERCEPTION OF AIR POLLUTION

#### INTRODUCTION

The complexity which characterizes the human significance of the physical environment precludes simple methods in its assessment. Interviews, though useful, constitute only a "snapshot" of a dynamic process which involves historical and cultural backgrounds, as well as current preoccupations transmitted by media or arising in the everyday lives of groups and individuals. A comprehensive study of the perception of air pollution must, therefore, take account of the milieu of the perceivers rather than rely on a spot assessment singular in place and time.

Accordingly, this discussion of findings begins by summarizing the broadly historical influences operating at national and local scales, as noted in greater detail in chapters five and six. Inferences from the Edinburgh case study, and their implications for methodology, inter-study comparisons, and theory are then examined.

#### NATIONAL HISTORICAL INFLUENCES

Over the centuries Britons have been infatuated with open coal fires. Initially the prerogative of the upper class, these fires came to symbolize the life of quality. Only because of the relatively mild climate could such a practice persist, while colder continental neighbours were forced, early on, to use the more efficient stoves and furnaces.

The smoke attendant upon inefficient combustion, particularly from industry, produced growing reaction among the gentry during the nineteenth century. Smoke abatement societies were set up,

initially in Manchester and London, and by the 1880's were organized nationally.

It is difficult to over-estimate the contribution of these societies to increasing public awareness of air quality. The national organization, realizing that their miniscule budget precluded an attempt to influence the general public directly, concentrated their attention on opinion leaders. Local authorities were subjected to an almost continuous flow of information about smoke control, and, later, about "smokeless zones". They provided speakers' notes, established the world's first journal devoted to air pollution, and helped with the preparation of Private Members' Bills for the House of Commons. In the latter role, the Clean Air Society was instrumental in bringing about both the Clean Air Act of 1956 and its 1968 revision. The present National Survey grew from this group's effort to make a visual and quantifiable demonstration of air contaminants at their 1942 Exhibition.

Air pollution control has not had high priority with British governments. Such regulations as were introduced frequently derived from crisis-produced public reaction. The characteristic government response was to cool agitation for legislative control by setting up a study commission. As often as not a war or financial emergency would intervene before any action could be taken on its findings. Ever present were the twin threats that if controls were brought in the financial outlay involved would drive some industries to the wall, or that British suppliers would be priced out of foreign markets. Thus, the possible loss of jobs held back pollution control.

Successive governments took the approach that smoke pollution was a local problem best controlled by means of Local Acts.

Governments did provide expert advice through the Alkali Inspectorate, and helped to co-ordinate air monitoring and the provision of boilermen's classes, where needed. Essentially, government acted only to provide services which local authorities could not, on their own, supply. Only after the 1952 London smog did it become obvious that national legislation was necessary to deal with public disquiet. But, even the controls which then ensued were permissive on the local authorities.

#### LOCAL HISTORICAL INFLUENCES

Edinburgh is located in the cradle area of Scottish coal mining and has a firm tradition of coal fires. If early travellers' accounts, and current observations may be trusted the residents also have something of a heightened tolerance for what, in other settings, might be considered environmental insults. Specifically, fouled pavements are still something of a natural hazard; open fires and gross dust pollution characterize demolition sites, with no effort at controlling either; garden rubbish is permitted to be burned within the city limits.<sup>1</sup> Although smell and smoke pollution have been attacked by successive Medical Officers of Health since the 1860's, major improvements in ambient air quality have resulted more from economic influences which made smokeless combustion in industry essential to business success, and dictated the replacement of the steam lorry and locomotive by petrol or diesel driven trucks

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1. Efforts have been made recently, by the Corporation Health Committee, to have smoking banned from buses and Corporation theatres. Also, the Rank Organization's cinema has been providing a "smokeless zone" seating option for about one year. The latter resulted from a policy decision taken in London.

and diesel electric engines, respectively. Domestically, the convenience of piped smokeless fuels outweighed their extra cost, particularly as more women joined the labour force. Thus, although the warnings and exhortations of the concerned few undoubtedly had some effect in expediting pollution control, by the 1950's they were pushing a wagon that was already well on the roll in the desired direction.

Edinburgh's smoke control programme was a masterful design, taking advantage of these existing trends, while balancing competing pressures from coal merchants and smoke control proponents. Yet it was designed to achieve significant pollution reduction, at minimum public expense. Enforcement of smoke control areas was somewhat indulgent, with warnings and advice used in marked preference to legal sanctions.

It is against this historical background that the interview responses from the Edinburgh case study must be considered.

#### THE INTERVIEW "SNAPSHOT"

##### The concept

Air pollution is a concept for almost all respondents, that is, it exists as a cognitive structure having definitional criteria and informational content. In addition, this construct has a strongly negative affective component.

Whether it also has salience, that is importance or priority, for the individual is less clear. Air pollution can be ignored, in most cases, without sudden and obvious consequences. Therefore, more pressing and immediate problems tend to supplant it in concern hierarchies. Also the absence of an obvious cause and effect linkage between pollution and many of its resultants underlines



the importance of information receipts in concept elaboration.

If interview data may be considered as a snapshot view of a conceptual continuum, certain developmental stages can be identified. It seems that as the informational size of the concept grows through incidental learning there comes a "critical mass" or critical new item of knowledge, at which stage air pollution qualifies as a matter deserving greater personal attention. A more or less active information search is initiated wherein, at least, there is a greater receptivity to information about pollution either directly, via sense experience or indirectly via conversation and media. In effect, this is a process of testing the hypothesis that air pollution deserves higher priority. If the hypothesis is confirmed some blame falls on those to whom responsibility for control was delegated. Interest in new information remains high, and some possibility of action arises. If the hypothesis is rejected, interest in further elaboration of the concept declines and its problem priority falls.

On the other hand, rejective mechanisms may be involved whereby one maintains a "closed mind", and new information is not assimilated into the concept. Such an effect is particularly suggested by the unwillingness of respondents to associate air pollution with their neighbourhoods, and by their reluctance to apply a recognized general health threat to their person. There is, however, no support in this Edinburgh data for a defensive denial hypothesis regarding those in dirty jobs.

Belief in a personal threat creates saliency and encourages information search. It seems likely that this would be particularly the case if one links pollution with personal exploitation. If one

sees waste in air as an imposition of the disposer on the subsequent consumer one is much more likely to react. This may be somewhat analagous to Starr's calculation that one is 1,000 times more willing to accept a hazard chosen voluntarily than to acquiesce when the threat is imposed. From this point of view, one smoker may actually resent smoke from others' cigarettes. At some non-rational level, one's own waste is not pollution; that term applies to other people's refuse. The hurdle to personal involvement seems very high.

Almost half of the Edinburgh sample are at the "Pre-percept" stage, in terms of Figure 11-1. About one third are in the "Information search" category and almost as many are undecided as are in the "Saliency" stage. Less than ten percent are "Action" oriented. The large majority of respondents are not worried about air pollution, nor do they see any necessity for involvement of the individual citizen. Rather, air pollution is a government problem that is, in their opinion, being well handled. The saliency of air pollution in Edinburgh at the time of the interview is approximately that obtaining in major U.S. cities ten years ago.

With smoke pollution in the city all but beaten, the remaining contaminants are less sensible, and thus more readily ignorable. In the future, as this trend continues, naive, primary sense experience of pollutants will be less possible, and learning will be an increasingly necessary prerequisite to perception.

In terms of Brunswick's probabilistic functionalism,<sup>2</sup> air pollution, insofar as it exists in the subjective hierarchies of concern of most respondents, is assessed small likelihood of inter-

fering with daily life. In terms of adaptation level theory<sup>3</sup> they are conditioned by the social acceptance of smoking in interior environments to ignore tobacco smoke, the most obvious and ubiquitous of air contaminants. As people become accustomed to murky air in cinemas and in their homes, at the same time a heightened tolerance to "stuff" in the air outside is developed. Thus, both for its ignorability, and for the human tendency to adapt the senses, air pollution is a prime candidate for editing out during the establishment of routines, whereby as much as possible of everyday life is made automatic, and what can be conveniently omitted from personal consideration tends to be ignored.

#### Characteristic respondent clusters

Generalized "pen portraits" are presented here for three respondent groupings which appear to hold contrasting views about air pollution, and to have characteristic socio-economic attributes. The sketches are polarized to the point of caricature. Only a few respondents in each group would fit the description totally, but all would tend toward their stereotype. These are drawn mostly from the factor analysis exercises, but also included are elements from the frequency tables. The exercise is intended to highlight the main response dimensions in terms of readily observable respondent characteristics.

The group least likely to be aware of air pollution as a problem is composed of old age pensioners. The typical member of this category has a low income and rather less formal education than the rest of the sample. He is likely to have also a low occupational social class assignment on the basis of his pre-retirement job. This person's concern hierarchy is limited to

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personal impact problems, such as the difficulty of getting on and off the new style buses, which are his usual method of travel in the city. There are no children in this household, but possibly one other adult of about the same age. He hardly ever goes outside Edinburgh, or travels far from his flat, which is most likely in a high air pollution area.

The defining member of the second group has more formal education, probably some years of secondary school, though is not a graduate. He most likely works in a dirty job, and is, therefore, given a low "class" rating. His income, too, is low, permitting something less than two weeks outside the city each year. He travels by bus. Television is his favourite recreation, as he watches more than twenty hours per week, preferring "adventure" programmes. He is only slightly more likely to be aware of air pollution than is the old age pensioner, yet, this person may dislike his neighbourhood. If that is the case a kind of "negative halo" effect seems to come into operation whereby he assigns to it a whole range of undesirable characteristics, including a serious air pollution problem.

The group most likely to notice and attribute salience to air pollution tend to live in the cleaner areas of the city. The typical member would be thirty to forty-five years of age, have a good job, and high income, and live in his own house with his spouse and young children. This person travels by car and spends three to six weeks outside Edinburgh each year. Although he watches very little television, his favourite programmes are documentaries and he has a high "information score" regarding air pollution.

This "pen portrait" exercise has relevance to the selection of target groups for a possible public education programme. The last group can, largely, be ignored; its members can collect enough information on their own. The first group would be difficult to influence, because of their limited time horizon. The prime target would be the middle category. One possible avenue to achieving a heightened awareness and understanding of environmental problems by this group is suggested by its penchant for television. Significantly, of the dozen respondents who gave "Doomwatch" as their favourite programme, every one was extremely concerned about air pollution. It is, of course, possible that their concern predated the programme, but the unanimity of the association is striking.

#### IMPLICATIONS OF THE RESEARCH

##### - For methodology

The card sorting questions in the March interview<sup>4</sup> obtained certain advantages over the usual list presentation of subjects for rating and ranking. Card shuffling allowed a random presentation order so that no name gained advantage by being presented always first or last. Respondents could pace the question and reorder cards during their answer. Interviewers reported that the game situation enhanced rapport and made a welcome break in the question-and-answer format. This technique, which has been the subject of a validation study by Cataldo and co-workers,<sup>5</sup> seems a promising approach for future studies in view of the above

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4. Questions 5, 6 and 15.

5. CATALDO, E.F., JOHNSON, R.M., KELLSTEDT, L.A., MILBRATH, L.W. Card sorting as a technique for survey interviewing. Public Opinion Quarterly 34 (2), 202-215.

advantages and their preliminary findings that data obtained with this method have at least equal validity to those obtained from list presentation.

Refinement of the standardized-questionnaire, sample-survey methodology for the assessment of perception of air pollution is a matter of some importance. The State of Iowa plans to use this approach as part of its legal definition of an offensive odour.<sup>6</sup> The technique is particularly suitable for odour sensing insofar as monitoring by other than the human nose has been difficult to effect. Also, where annoyance standards, rather than health and material damage criteria, are to be enforced, the people directly involved must at some stage express their views. The sample survey technique offers a standardized setting for such expression. It is obviously desirable to make such surveys as economical of interviewer and respondent time as consistent with reliable results. To this end, the shortening of the Edinburgh questionnaire by omission of items found to be redundant in the factor analysis exercise offers a promising technique for development of a standardized, validated questionnaire.

- For cross-study comparisons of findings

Detailed comparisons of questionnaire responses with findings from other studies are of doubtful value, because of differences in design, administration, and purpose. In a more general sense, each set of interview information represents an estimate of public thinking about air pollution at a particular point in an often rapidly changing pattern of local priorities, and conventional

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6. Time Magazine.  
January 1, 1973. P.28.



knowledge. Therefore, the interview snapshot loses relevance with increasing spatial and temporal separation from its origin. Similarly, the cultural and historical "distance" between populations complicates comparison. Despite these drawbacks, certain similarities do exist across studies insofar as high-education, high-social-class respondents tend to express concern about air pollution. At this level of generality, the most striking features of the Edinburgh data are the strong relationship between age and response pattern, and the relatively low priority of air pollution as a problem.

#### - For theory

Natural hazards theory fits air pollution best where extreme episodes, such as the London smog of 1952, occur. The adaptation of that theory used in this study, though useful, was extremely limited. Its main strength was recognition of the complex threshold involved in awareness of air pollution. (Figure 7-4) This process could now be construed in terms of conceptual development, as suggested in Figure 11-1, and of belief in personal threat. The latter now seems to involve self in interaction with three principal dimensions, summarized in Figure 11-2 as "Authorities", which includes government, industries, and experts; "Others", i.e. friends, neighbours, and citizens generally; the "Threat", in this case, air pollution. In this figure primary actions are shown as solid lines, external reactions by dashes, and possible personal reactions in dots.

The respondent's thoughts about authorities, others, and the threat, all in relation to himself, will influence whether he reacts to the risk, and if he does, which direction his action takes.



The form that this action might take will also depend upon his concept of these entities, that is, upon the amount, nature, and subjective reliability of his information about them, and, resulting from this, upon his attitude toward them, i.e. are they "good" or "bad" for his purposes? A complicating factor is the person's belief in ideals, and his desire to conform to these more or less subjective standards. Such "capsules" in the mental environment would profoundly affect action in the external environment. (Figure 7-2)

As society becomes increasingly complex, the necessity to delegate responsibility becomes greater. Faith in the benevolence of institutions becomes crucial; if government and employers are not seen to be acting on one's behalf, the whole range of existing controls become suspect. New variables that thus become relevant are connected with attitudes to protest, collective and individual; perceived responsiveness of neighbours, industries, and governments to criticism; and strength and direction of political affiliation. What is needed is a validated test of these dimensions so that results may be interpreted in a context beyond that afforded by a one-off study.

In more general terms, it is useful to construe the process by which significances are attached to environment as a dynamic interaction motivated by need. The most firmly held of such subjective definitions of surroundings derive from first-hand experience, with personal involvement. Individual significances in abstracted aggregation form the cultural meaning of the physical landscape. As world communications improve, the concept of world or human culture becomes more meaningful in terms of defining a

common reservoir of beliefs about what is true and untrue; desirable and not.

With modern technology men become a more potent force than ever before in consciously altering their physical surroundings, for the good or ill of themselves and others. For example, satellites offer new capacity to gain objective knowledge and control of the earth's resources, yet add new dimensions to the nuclear threat. If the good use is to be chosen, the ideas and ideals that men hold about their world take on paramount importance as it becomes increasingly recognized that for groups as for individuals it is the perceived environment that exists in the mind that is the basis and limit of action.

## CONCLUSION

Interview research involving sample surveys of the general population has utility for assessing local feeling about pollution control. For larger scale action, either at national or international level, the views of agencies and officials may well have more relevance as an aid to decision-making. For example, when the British government prepared background papers for the Stockholm Conference, they sought, primarily, qualified and/or committed opinion<sup>1</sup> as their gauge of concern. Although the following comments are directed mainly toward surveys of the general public, the sample interview approach is adaptable for use with specially selected groups.<sup>2</sup>

## RECOMMENDATIONS FOR PUBLIC POLICY

Any attempt to educate or influence general public opinion about air pollution, or other environmental matters, would best be presented incidentally in television "adventure" programmes such as "Softly, Softly" or "Doomwatch". The people least aware and concerned about the environment are unlikely to watch documentaries.

No one respondent mentioned a global pollution hazard, though ample opportunity was afforded in open-ended questions. Such a possible threat was clearly demonstrated by the consequences of above ground testing of atomic weapons during the 1950's. More

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1. Sinews for survival.  
Department of the Environment. H.M.S.O. 1972. Pp. 71-73.
  2. E.g.:  
HAGEVIK, G.H.  
Decision-making in air pollution control.  
London. Praeger Publishers. 1970.

recently other possibilities have been suggested, including build up of dust and/or CO<sub>2</sub> in the atmosphere, and deterioration of the ozone layer due to super-sonic flight. Without making any judgement here on the validity of these claims, it would seem advisable to recommend more teaching on possible effects of pollutants on global climate in school curricula, and, in some form, for the general public.

There is a generally observable perceptual adaptation to air pollution in that tobacco smoke is widely ignored. If it is desired to encourage awareness of ambient pollution, a useful first step would be the destruction of the adaptation to this most observable pollutant by discouraging smoking, and by rendering the habit socially unacceptable in public places.<sup>3</sup>

The approach most likely to effect a more responsible attitude toward the environment is to emphasize the personal stake that each member of society has in the maintenance of common property resources. For instance, if an individual considers a smelly lorry as depriving him of his personal fair share of clean air, he is much more likely to make some complaint about it, and much less likely to operate such a vehicle.

Any new anti-pollution measures should be presented as deriving in some way from the "smokeless zone" idea in order to take advantage of the strongly positive feelings associated with that concept. For the same reason, the present smoke control programme could be rapidly stepped up, in Edinburgh, without causing adverse public reaction.

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3. Currently (May 1973) an anti-smoking campaign involving posters and television commercials is in progress. Also the Government has published a table showing the tar content of popular cigarette brands (April 1973).

## RECOMMENDATIONS FOR FUTURE STUDY

This project suggests hypotheses that might be tested in other studies. Among these are:

- a) Age is more strongly related to views about air pollution than was previously recognized;
- b) Those expressing dissatisfaction with their neighbourhood will also be critical of a whole range of potential local problems;
- c) Intermittent exposure to high pollution levels militates for increased problem awareness.

Card sorting in particular, and game simulations in general, provide a promising data collection possibility. However, the reliability and validity of such experiments require further attention.

Future studies of this type should include deeper consideration of personality characteristics, preferably by use of existing standardized, validated tests.